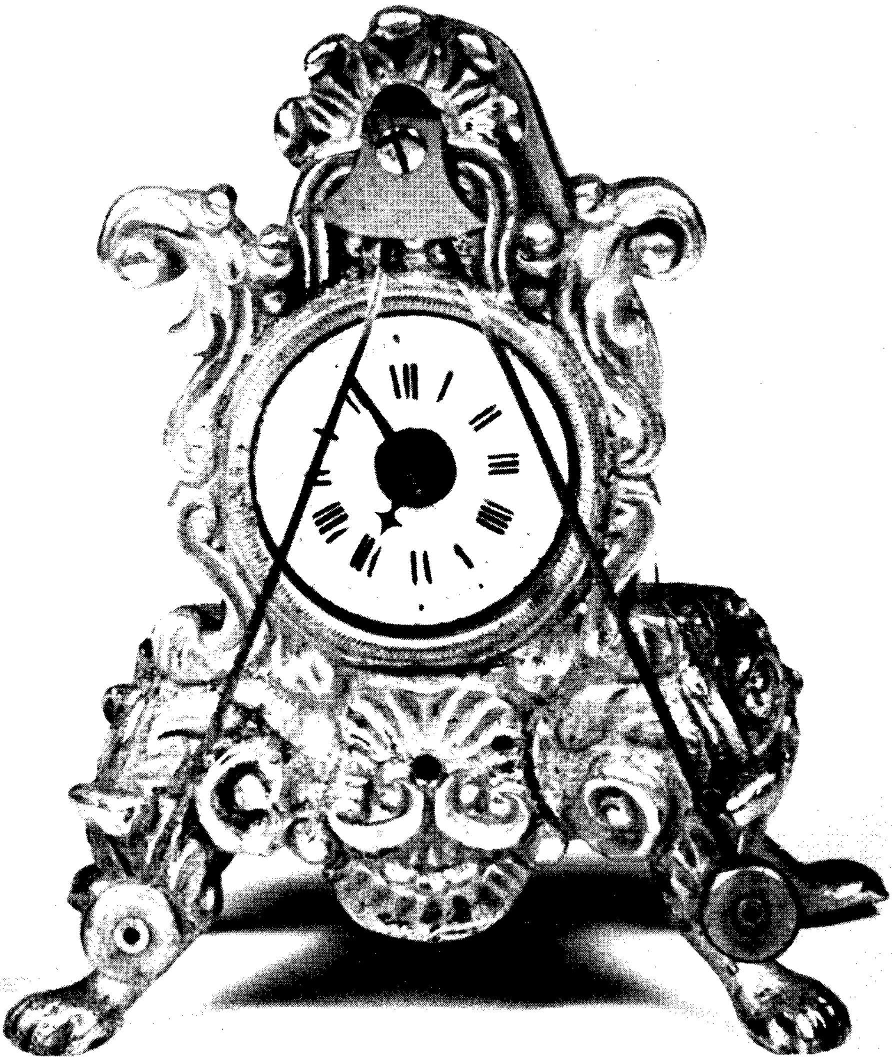
THE MODEL ENGINEER

Vol. 106 No. 2658 THURSDAY MAY 1 1952 9d.



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

1ST MAY 1952 VOL. 106 NO. 2658

SMOKE RINGS

Our Cover Picture

● HERE IS another clock of unusual and possibly unique design, which has been brought to our notice by Mr. R. H. Pilcher, of Aldwych, London, W.C.2, who informs us that in spite of many enquiries, he has failed to find out anything about its origin, or anyone who has seen its like before. It is a gilt bracket clock, of ornate design suggesting French manufacture, and its diminutive size (slightly less than 2 in. high), can be estimated by comparing it with that of the safety match seen in the photograph. The movement is fairly simple and normal, with the exception of the escapement, which is distinctly novel. The 'scape wheel is mounted at the top of the motion plates, and immediately above it are two parallel arbors, close together, with toothed segments geared together in equal ratio. Each of these carries a half-pallet in the centre, engaging the 'scape wheel, and the ends of the arbors extend through the motion plates to project in front of the face. To each of these projecting ends a small pendulum is attached, extending down almost to the base, and swinging in synchronism, but in opposite phase. Mr. Pilcher suggests that the term "pendulum" in this case may be a misnomer, as he does not think they swing to a natural frequency but act rather as a balance wheel or "foliot." In action, the clock is fascinating to watch, as the tiny pendulum-rods, like the antennae of a butterfly, cross and re-cross each other in front of the face, at lightning speed and in a ridiculously fussy manner. The clock is stated to be a tolerably good timekeeper. If any of our readers have seen a similar clock, or can give us any information of the maker or date of manufacture, we shall be greatly obliged.

Montreal Live Steamers

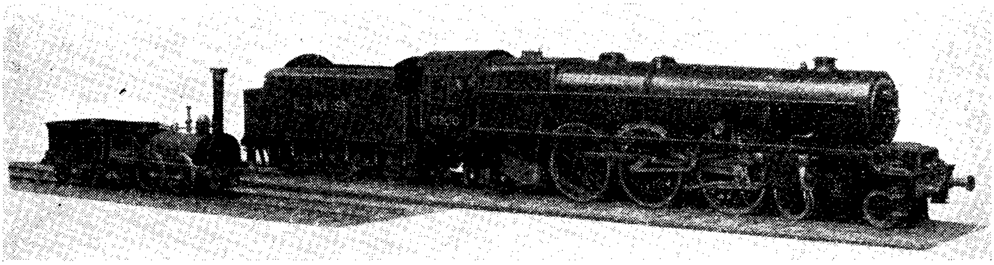
● MR. CECIL F. HARDING, secretary-treasurer of the Montreal Live Steamers Corporation, informs us that the corporation's fifth annual meeting took place late in March and was very well attended. Harry Turnbull was re-elected as president, and Meridith Massie was elected vice-president. Mr. Harding was appointed to the important post of secretary-treasurer for the sixth term of office, which is strong evidence of the esteem and confidence in which he is held by the members.

Plans have been made to hold a locomotive "meet" at the track on Saturday, May 24th, when it is hoped to put on a good show.

There are probably a number of locomotive enthusiasts in and around Montreal who do not know of the corporation's existence ; if this note should catch the eye of any of them we suggest that they should get into touch with Mr. Harding, whose address is 5850, Coolbrook Avenue, Montreal 29. Telephone : Exdale 6170.

An Interesting Comparison

● THE PHOTOGRAPH reproduced on this page provides an interesting comparison between ancient and modern locomotives, by means of two very excellent models. The two locomotives represented are: the *Comet*, built in 1835 by Hawthorns, for the Liverpool & Manchester Railway, and *The Princess Royal*, designed by Sir William Stanier and built at Crewe in 1933 for the London Midland & Scottish Railway; the models are to ¾-in. scale and are exhibited



in the Municipal Museum of Science and Industry, Newcastle-upon-Tyne.

We have also received a copy of the catalogue compiled by the Hon. Curator, Mr. H. W. Davis, M.I.C.E., which contains a plan of the museum as well as brief particulars of each exhibit. We can recommend a visit to the museum by any reader who is interested in the history of science and technology.

The Model Railway Exhibition

● THE CENTRAL HALL, Westminster, was the mecca of model railway enthusiasts who flocked there in their thousands to see the annual exhibition organised by the Model Railway Club. There was a marked change in the general layout of the exhibition, and we think that the new ideas, which were apparent in nearly every section, must have been to the advantage of all concerned.

For the first time, there was a complete scenic working layout in 2-mm. scale, and we were interested to note that the locomotives, rolling-stock and all scenic accessories were remarkably true to scale, even in this very small size. The whole layout presented a most attractive picture, though we feel that the greens of the meadows, trees, and hedges were rather too vivid.

From this very small scale to 5-in. gauge represented the range covered by the exhibition generally, and some very nice work was to be seen, especially among 4-mm. and 7-mm. passenger coaches. There is still too much disagreement with regard to the pre-grouping, and even pre-nationalisation, colours of locomotives and stock; but, perhaps, this problem will never be settled to the satisfaction of everybody! The chief difficulty, now, is that no official records of the colours used seem to be available, and old coloured plates are often unreliable, partly because of inherent fading and partly to original inaccuracies.

However, the exhibition was very enjoyable, and we were much struck by the large amount of new work to be found there.

Locomotive Slipping at Speed

● YEARS AGO, there was published in our correspondence columns a lengthy discussion on the subject of the slipping of locomotive driving wheels at speed. Several of the writers doubted the accuracy of the testimonies of drivers and others who stoutly maintained that the phenomenon was well known; others put forward various explanations which, however, were not generally acceptable.

Since that time, dynamometer records have proved that slipping of the wheels does actually occur; but, due to the fact that its occurence is unpredictable and intermittent, we are just as far as ever from a satisfactory and convincing explanation.

The phenomenon has recently been investigated on the New York Central Railway, U.S.A., and the results appear to confound all previous theories as to the cause of the slipping. For one thing, these investigations have definitely established that steam locomotives are not the only culprits; diesel-electric locomotives seem to be even worse affected. To quote an actual instance, special appliances were fitted up on two twin-unit diesel-electric locomotives. On one occasion, it was observed that the leading pair of driving-wheels had run 206 miles while the locomotive had run only 146 miles; on several other runs, slipping of wheels at speeds exceeding the equivalent of 120 m.p.h. were observed, often more than 50 per cent. of the rated speed of the locomotive itself.

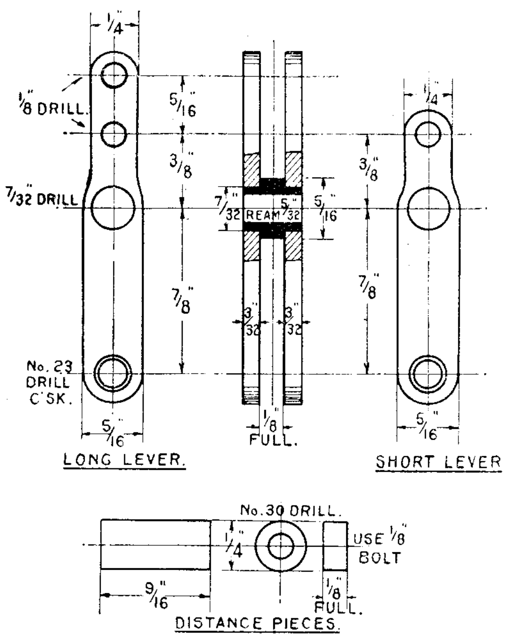
This seems to suggest that a new outlook on the problem will have to be thought out; obviously, the effects of balanceweights and centrifugal force can be ruled out. But we are reminded that we have often watched miniature locomotives being driven at high speed, and that frequently there is no doubt whatever that the driving wheels have been slipping furiously, in spite of—or, perhaps, even because of—the high speed at which the engine is running. True, this state of affairs is most likely to be aggravated by the fact that many drivers of miniature locomotives seem to be under the impression that the only way to reach high speed is to open the regulator as wide as it will go, and put the reverser in full gear! The problem, however, is still with us, in full size as well as in miniature, and the results of future investigations are being awaited with the keenest interest by all concerned.

"JULIET" WITH OUTSIDE VALVE GEAR

by "L.B.S.C."

Details of the Baker Valve-Gear

LOCOMOTIVE builders who were not familiar with the Baker valve-gear, should by now be pretty conversant with it, in view of the dissertation in the last instalment; and to "complete their course," in a manner of speaking, I give an end view of the whole doings, as erected in the gear frame. You now see exactly what is needed, and where to put it. The reverse yoke is made up of two double levers, one of which is longer than the other, for connection to the reach rod, by which it is operated. It fits over the gear frame, the lower ends of the levers being pinned to the gear frame through the holes provided. Each pair of levers is provided with a distance-piece, in the form of a bush, which serves a double purpose, inasmuch as it provides a long bearing at each side, for the trunnion-pins of the radius bars. This arrangement constitutes a built-up version of the one-piece drop stamping forming the reverse yoke on the full-sized job. On the latter, the reverse-rod connection is made in the middle; but for our purpose, it is more convenient to put it at the side, as shown, apart from simplifying the construction. The two radius bars can be seen swinging from their trunnions; they are set in at the lower ends, to meet the gear connecting-rod, to which they are pinned. The end of the horizontal arm of the bell-crank can be seen between the jaws of the fork at the top of the gear connecting-rod. I guess that should make everything quite clear, so we can now proceed to construction; and I shall be mightily surprised if you don't prefer this simple job, to carving out curved and slotted links, and fitting dieblocks to them. I personally prefer Baker to Walschaerts, which is why I fitted it to *Tugboat Annie.* Now let's get busy.



Reverse yoke

Reverse Yokes

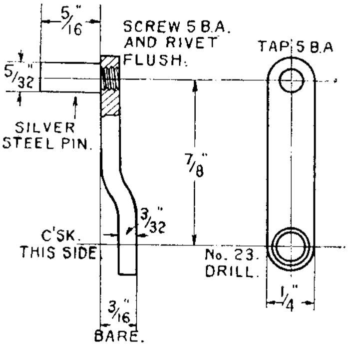
All four levers in each yoke, can be made from $\frac{5}{16}$ in. × 3/32-in. mild-steel strip. You don't need to bother about using rustless material, as the oil will keep the rust away all right. Mark off one long lever, and one short one, to the dimensions given in the illustration; and first of all, drill all the holes with 3/32-in. or No. 40 drill. Cut pieces of steel to the overall length of the other six levers, three long, three short; clamp each *separately* to the drilled lever, and use the latter as a jig to drill the blank. It is important, especially in a valve-gear, that the pieces should be exactly similar; and if an attempt is made to drill the lot at once, the drill may wander, and the bottom one will be different from the upper ones. Now carefully open out all the holes, to the sizes shown in the drawing. The ends of the levers can then be rounded off, preferably by aid of a filing jig or button, as described in the *Tich* notes. A rub or two on a bit of fine emery-cloth, or similar abrasive, will make them look ever so pretty, especially if a bit of beeswax is rubbed on the emery-cloth first.

The bushes are turned from a bit of $\frac{5}{16}$-in. round bronze or gunmetal rod, held in three-jaw. Face the end, centre, and drill down $\frac{3}{8}$ in. depth with No. 23 drill. Turn down 3/32 in. of the outside to 7/32 in. diameter, a tight fit in the 7/32-in. holes in the levers. Part off at a full $\frac{5}{16}$ in. from the end; reverse in chuck, and repeat operations on the other end, leaving a piece full diameter and a full $\frac{1}{8}$ in. wide between the shoulders. Four bushes are needed. Squeeze one into the 7/32-in. hole in one of the levers, and squeeze another lever on the other end, lining up the two levers by putting the shank of the No. 23

drill through the bottom holes. Then poke a 5/32-in. parallel reamer through the bushes.

The distance-pieces are made from $\frac{1}{4}$ in. round steel rod. Chuck in three-jaw, face the end, centre, and drill down about $\frac{7}{8}$ in depth with No. 30 drill. Part off at a full $\frac{9}{16}$ in. from the end. Repeat operations, then drill again and part off four slices, each a full $\frac{1}{8}$ in. thick. Face the end truly before parting off each piece. Most parting tools are like folk who gossip, they aren't particular about sticking to the truth; so rechuck each piece, long and short, with the parted ends outwards, and carefully face off the ends dead square. The longer ones should be exactly $\frac{9}{16}$ in. long and the shorter ones a wee bit over $\frac{1}{8}$ in., the same as the distance between the shoulders of the stepped bushes.

The bolts are easily made from pieces of $\frac{1}{8}$ in. round silver-steel, $1\frac{1}{2}$ in. long with $\frac{1}{8}$ in. of $\frac{1}{8}$-in. or 5-B.A. thread on one end, and about $\frac{1}{4}$ in. on the other. Screw an ordinary commercial nut tightly on the short end, and file the projecting rod flush with the nut; I make all my long bolts thus. To assemble the yokes, all you have to do is to put the short distance-pieces between the two levers just above the bronze bush, level with the $\frac{1}{8}$-in. holes. Put a bolt through one pair, then put on the long distance piece, put on the other "twin" lever, and secure with a nut. The lower ends of the levers can be lined up temporarily by putting the No. 23 drill through all the holes; but they will automatically line up when the gear is erected on the frame. I nearly forgot to mention that these bottom holes should be slightly countersunk on the outside; you can do that before putting in the long bolt.



Radius bar

Radius Bars

The four radius bars are made from $\frac{1}{4}$-in. × 3/32-in. mild-steel strip, the job being done in a manner somewhat similar to making the reverse yoke levers. Mark out and drill one, then use as a jig to drill the others, one at a time. The $\frac{7}{8}$ in. distance between centres is what they should be *after* bending; so if about 1/64 in. is allowed for the loss by offsetting, you'll be all right. Drill all the holes No. 40 for a kick-off; then, after bending, tap the upper holes 5 B.A. (or $\frac{1}{8}$ in. × 60 would be better, if you have the necessary tap and die) and open the bottom holes with a No. 23 drill. Countersink on the outside of the bar; that is, the same side as the trunnion pin. As regards the actual bending, this can be done in the bench vice in the manner I have often described, viz.: using pieces of packing (in this case, bits of the self-material, 3/32-in. strip, would do) on opposite sides of the piece to be bent, at each side of the location of bend; or it may be done simply by putting the bits of bar upright in the vice jaws, and judiciously coaxing them over, by aid of a stout pair of pliers, or a hand vice. Being fairly strong in the wrist, despite the onward march of Anno Domini, that was all I used, until the Diacro bending brake came to my workshop; since then, as the famous soap advertisement used to put it, I've used no other. The blessed thing reduces bending problems to an absurdity!

To make the trunnion pins, chuck a piece of 5/32-in. round silver-steel in the three-jaw; face the end, and turn down $\frac{1}{8}$ in. length to $\frac{1}{8}$ in. diameter. Screw this to match the tapped hole in the bar, and part off at $\frac{5}{16}$ in. full, from the shoulder. Reverse in chuck, and very slightly bevel the end. Four will be needed. Slightly countersink the ends of the tapped holes, screw each pin very tightly into the bars, rivet the projecting end of the screwed part into the countersink, and file off flush.

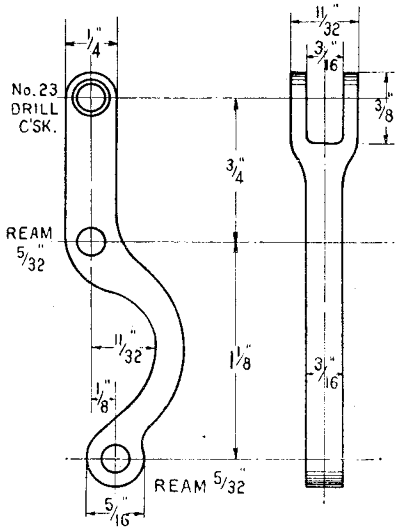
Gear Connecting-rods

The "sickles" as they are frequently called, from their resemblance to that well-known agricultural implement (Third Programme again) can be made from $\frac{3}{8}$-in. × $\frac{5}{16}$-in. mild-steel, or nearest available size larger. The forked end is formed exactly as described for other valve-gear forks, with a $\frac{3}{16}$-in. milling cutter on an arbor in the chuck, or by end-milling, or as a last resort, by filing. The metal is then milled or filed down to the sizes shown in the illustration, and carefully bent to shape. Easier said, or written about, than done, says Bro. Inexperienced Worker. Quite true, as far as it goes; but everything is easy when you know how, and if there is any difficulty in bending cold, make it red-hot. The red-hot metal will bend as easily as lead. Have the metal longer than required for the job—there is no need to reduce the thickness of the unwanted part—and after bending, the surplus length can be sawn off. A piece of iron gas pipe slipped over the end, gives plenty of leverage for cold bending. Trim to shape with a file. Be careful when marking out, especially noting the offset at the bottom; the eccentric-rod connection is $\frac{1}{8}$ in. behind the vertical centre-line of the upper part. Drill the holes No. 30 to start, then open up and ream as shown. The lowest hole may, with advantage, be casehardened; or alternatively, it could be drilled 7/32 in. and a bronze bush squeezed in, the bush being reamed 5/32 in. I usually bush mine.

Anybody who isn't very successful at what my one and only niece would have called "bendification" in her schooldays, could cut the gear connecting-rods from $\frac{3}{16}$-in. steel plate, to the shape shown, and braze a small block of steel

on the upper end, to form the fork. Followers of these notes will remember that I usually recommend brazed-on blocks, for forming the forked ends of long reach-rods, or reversing rods.

The bell-cranks may be castings, if our approved advertisers care to oblige; in which case they will need little doing to them. Chuck one end of the bearing in the three-jaw; set it to run truly, face the end, centre, drill through



Gear connecting-rod

with No. 23 drill, and ream 5/32 in. Face off the end to $\frac{3}{8}$ in. from centre line, and turn down the outside to $\frac{1}{4}$ in. diameter. Reverse in chuck, turn down the other end to same diameter, and face off to $\frac{3}{4}$ in. overall length. Mark off and drill the other holes with No. 23 drill, finishing with 5/32-in. reamer.

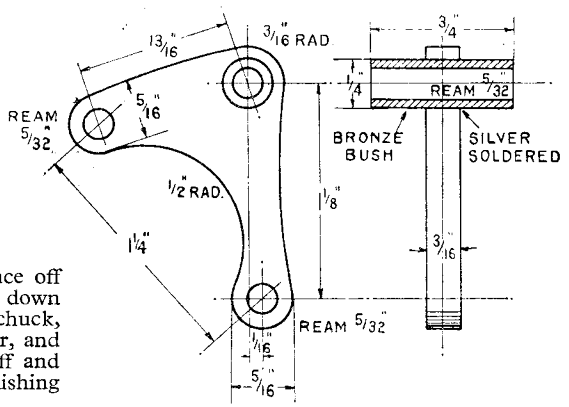
The bell-cranks can also be cut from $\frac{3}{16}$-in. steel plate, or good quality brass would do quite well. When marking out, draw the two vertical lines first, and mark the location of the bearing, at the top of the left-hand line, with a centre-pop. Make another, $1\frac{1}{8}$ in. below it, on the right-hand line. Now set your dividers to $\frac{13}{16}$ in. between points, and strike an arc, with the top centre-pop as fulcrum point, to the left of same, and a little below. Reset dividers to $1\frac{1}{4}$ in. between points, and strike another arc from the lower centre-pop, cutting across the first one. Where the lines intersect, at the "level crossing," make a third centre-pop. Drill all the holes $\frac{1}{8}$ in. or No. 30, open those at the ends of the arms with No. 23 drill, and ream 5/32 in. Open out the hole in the knee, to $\frac{1}{4}$ in., and fit in it a bronze bush, $\frac{1}{4}$ in. diameter, $\frac{3}{4}$ in. long, reamed 5/32 in. Make it in the same way as described for the distance-pieces in the middle of the reverse yokes; squeeze it in, and silver-solder the joint. The spindle is a $1\frac{1}{8}$ in. length of 5/32-in. silver-steel, one end of which is reduced to $\frac{1}{8}$ in. diameter for $\frac{1}{4}$ in. length, and screwed $\frac{1}{8}$ in. or 5 B.A. to take a commercial nut.

How to Assemble the Gear

Assembly and erection are easy jobs. No pin turning is needed, as the pins are merely bits of 5/32-in. round silver-steel. Put a radius bar at each side of the gear connecting-rod, bottom holes in the former against the middle holes in the latter. Put a bit of silver-steel rod about $\frac{7}{16}$ in. long, through the lot; this should be a drive fit in the holes in the radius bars, and a nice running fit, without shake, in the hole in the gear connecting-rod. Rivet into the countersinks, and file flush. The rod should swing freely between the bars, but without any sideplay.

Put the shorter extremity of the bell-crank between the jaws of the fork at the top of the gear connecting-rod, and pin it exactly as described above, leaving it free to oscillate in the fork. File the ends of the pin absolutely flush, or they will run foul of the radius bars when the gear is in operation.

Take the reverse yoke apart by undoing the bolt, put the double levers on the radius bar trunnions, as shown in the assembly view, and replace the bolt. Don't forget that you need one set of gear to be right-handed, and the other



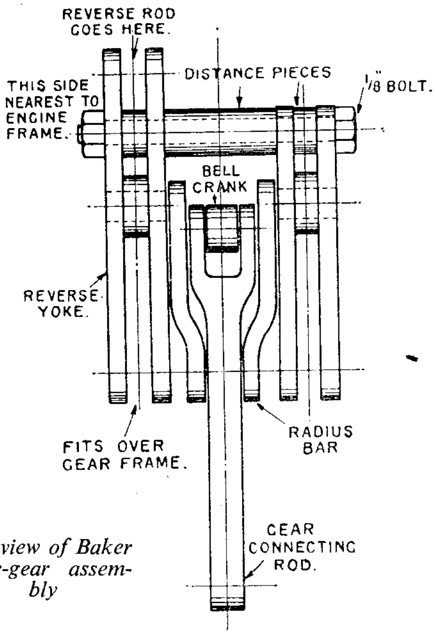
Bell crank

one left-handed, so put the longer lever of the reverse yoke on opposite sides of the two gear sets.

Take the bell-crank spindle out of the gear frame, and drop the assembled gear into position between the sides of it. The gear frame sides go up between the two parts of each double lever. Line up the bell-crank bearing with the upper holes in the gear frame; replace bell-crank spindle, putting it through the lot, and secure with the nut outside the frame. Line up the bottom of each double lever, with the hole at the bottom of the gear frame; put pieces of 5/32-in. silver-steel through, rivet into the countersinks, and file flush. The reverse yoke shouldn't swing quite so freely as the joints on the gear connecting-rod and the bell-crank; but at the same time it must not be stiff to operate, otherwise it will throw too much strain on the reach rods and the cab lever, with the possibility of bent rods.

The position of the gear-frame is clearly shown in the elevation and plan views of the complete

valve-gear, shown in the previous instalment; and as instructions have already been given for locating the gear frames at the tops of the guide-bar brackets, and drilling the screw-holes in same, all that remains to be done, is to put each gear assembly in place, and secure it to the top of the guide bar bracket by aid of bolts, or screws and nuts. Use $\frac{1}{8}$ in. or 5 B.A. for the upper holes, and 3/32 in. or 7 B.A. for the lower holes. One of the upper bolts will go through the angle which supports the joint between the motion bracket and the guide bar bracket; but that doesn't matter a Continental, it only calls for a longer bolt. The angle being brazed or silver-soldered as per instructions, there are no rivet heads to get in the way of the nuts or screw heads. It wouldn't be a bad wheeze to use small spring washers under the nuts, as the gear frame suffers considerably from racking strains when the engine is at work, especially if the driver happens to be a bit of a speed merchant, as many of them are. This engine isn't built for speed; but nevertheless like all the locomotives described in these notes, she *can* go, if required—'nuff sed! Just one tip; when erecting, make certain that the gear frames are put on the correct sides of the engine; the longer lever of the reverse yoke should be nearest the engine frame.



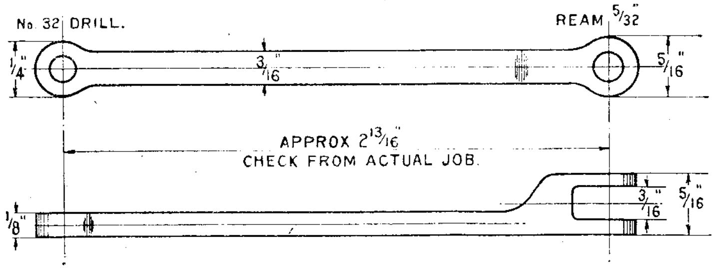
End view of Baker valve-gear assembly

If this is the first time you've made a Baker gear, you can now see exactly how it works. Put the reverse yoke as far forward as it will go, and waggle the gear connecting-rod back and forth. The bottom end of the bell-crank will immediately move in step with it. Now pull the reverse yoke slowly back, still keeping up the waggling act. You will notice that the bottom end of the bell-crank reduces its travel, finally stopping altogether when the reverse yoke reaches mid-position—yet some folk assert that the Baker gear won't notch up! As the reverse yoke passes mid-position, the bottom of the bell-crank resumes business, but this time in the opposite direction to the movement of the gear connecting-rod. The travel gradually increases until the reverse yoke is as far behind centre, as it was originally ahead of centre, and the engine will then be in full back gear.

Valve-rods

The valve-rods are made in exactly the same manner as the combination levers, from $\frac{1}{4}$ in. × $\frac{5}{16}$-in. mild-steel, so no repetition of process is necessary; but the exact length must be obtained from the actual engine, which is easily done in the following way. Put the reverse yoke in such a position, that when the gear connecting-rod is moved back and forth, the bell-crank remains stationary; this position can be found, as described directly above. Now set the crosshead exactly at half stroke, with the combination lever vertical, the valve spindle also being in mid-travel. If you apply a pair of dividers to the centres of the holes in the bottom of the bell-crank, and the lower hole at the top of the combination lever, the distance between the points will be the exact length to make the valve-rod, between centres of holes.

Warning: *check each side separately*, and make the rods to suit, marking them R and L.



Valve-rod

The eye end of each valve-rod is pinned to the lower hole in the combination lever, between the jaws of the fork, by a flush pin as described above. The forked end passes through the holes in guide bar bracket and end of gear frame, and is attached to the bottom end of the bell-crank by a pin, formed by turning down each end of a $\frac{9}{16}$ in. length of 5/32-in. round silver-steel, to 3/32 in. diameter, and screwing them 3/32 in. or 7 B.A., leaving $\frac{5}{16}$ in. full length between the shoulders. Put it through the holes in bell-crank and valve-rod fork, and secure with a nut on each end. The nuts must not nip the fork and close it in.

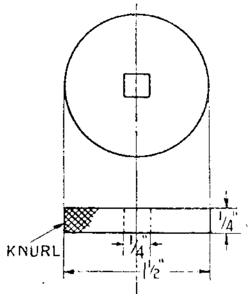
A Re-seating Tool

for Standard $\frac{1}{2}$-in. Water Taps

by W. D. Bracher

I HAVE found that a number of leaking taps have been only temporarily cured by fitting new washers and that the permanent cure was to re-seat the valve.

The little tool described here will do this job

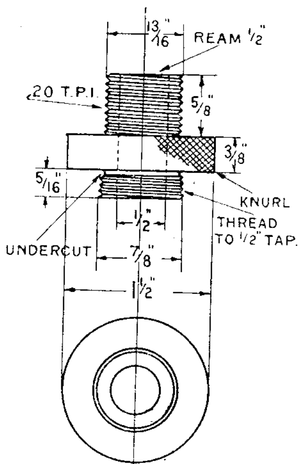


KEY

in a few minutes and should raise you a bit in the estimation of the domestic authorities!

It also forms an ideal exercise in turning and thread-cutting, etc., for the beginner.

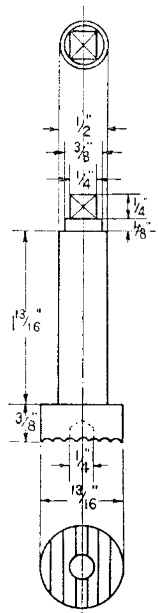
The sleeve is made first, and the main points to watch are: Get the threads dead square to the flange and the bore likewise. Undercut the thread for the tap to enable the flange to seat true on the tap. The material used is brass or aluminium. If aluminium is used, on no account leave the



SLEEVE

reamer inside the sleeve when storing, or electrolytic action will ruin it.

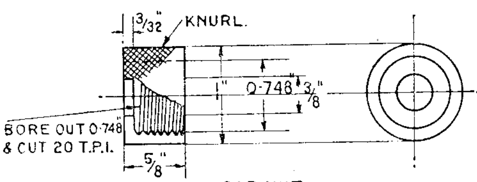
The reamer is made from any good quality steel, the original being made from cast-steel which needed no hardening. The teeth can be either milled or fly-cut, or just filed and need not be rounded out between, but can be vee'd. Care must be taken to get them even and square to the shank.



REAMER

The shank is made a good running fit in the sleeve.

In operating, remove the top of the tap and valve. Screw in the sleeve complete with reamer, screw down the cap nut until it applies a little pressure on the reamer—but only a little—and then, placing the key on the squared end of the reamer, turn smartly to and fro a few times,



CAP NUT.

keeping a little pressure on the reamer by means of the cap-nut.

When the seat is O.K., clean out and fit tap with a new washer.

THE KODAK EXHIBITION, 1952

THE Kodak Society of Experimental Engineers and Craftsmen got together a remarkable collection of models and allied exhibits for the 1952 biennial exhibition held recently at the Kodak Hall, Wealdstone. It covered a wide variety of work, though the sections devoted to ships and locomotives were the strongest, numerically. The general standard of workmanship was high and, taken as a whole, the exhibition was one of the most interesting which this society has organised so far.

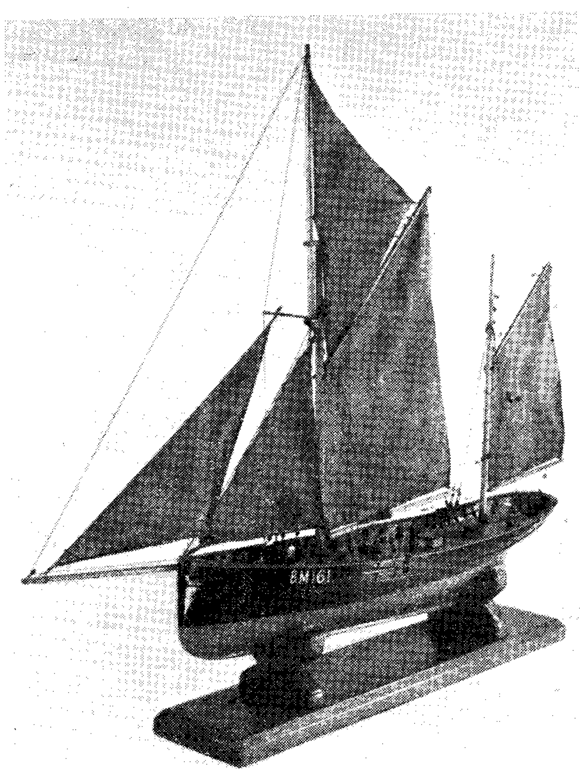
A very fine $\frac{3}{4}$-in. scale L.M.S. 4-6-2 locomotive, No. 6200, was an outstanding example in its class in the Competition section; the workmanship in this engine was excellent, and the general adherence to scale proportions and outline was admirable; clearly, the greatest care had been taken during the whole of the construction, right down to the smallest details.

A very attractive job was a $\frac{13}{16}$-in. scale G.W.R. 2-4-0 engine, No. 73, *Isis*, with double frames and outside bearings. The accuracy of the general details and construction was commendable; but there are some minor errors, such as the shape of the top of the safety-valve casing and the use of round instead of flat section for the safety-valve releasing lever, while the Indian red colour of the outside frames and splashers is too light. The lining of this model, especially on the flat surfaces, leaves much to be desired. The leading axleboxes should not be black but the same colour as the frames, while the tender axleboxes, which are of the correct flat type, should be polished brass. The characteristic flat ring which should surround the smokebox door is missing, and we think that the curves at the base of the dome are too blunt. The errors would not be difficult to correct, and if they were, the model would certainly deserve a high award.

A most unusual and extremely interesting job was a 5-in. gauge replica of an old Aveling & Porter 2-2-0 type geared locomotive. The accuracy of this model is very highly commendable.

Among the loaned locomotives was a 5-in. gauge model of the old Liverpool & Manchester Railway engine *Lion*, the workmanship in which is of the highest class. This most intriguing job is, as yet, only partly finished; but there is already more than enough to ensure that it will be a most outstanding engine. We hope, very much, that we shall see it again and that we shall be able to illustrate it, in due course.

Among the ships was a model, about 2 ft. long, of the old 74-gun *Implacable*. We do not recall having seen this famous and now-lamented old ship in miniature before, and this one is obviously the result of painstaking care and accurate observation, possibly inspired by the shameful fate of the prototype! Had it been in the competition it would have won a high award.

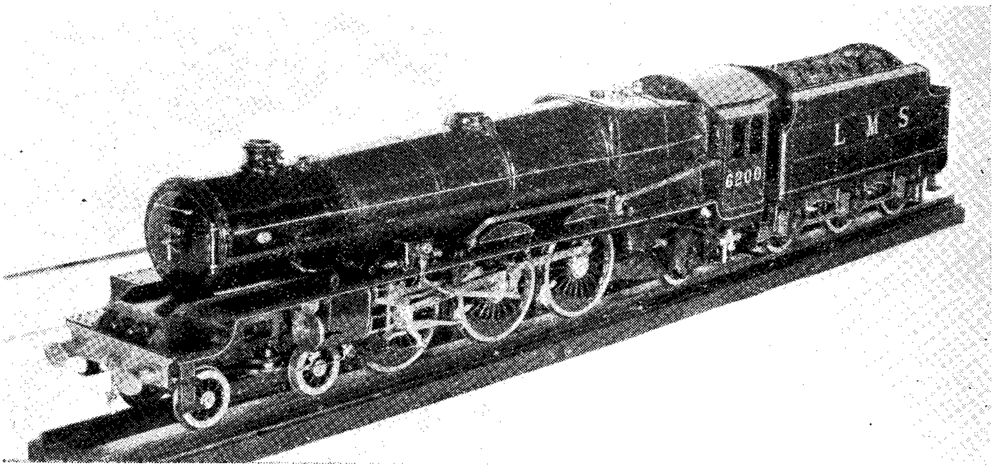


A model Brixham trawler, "Valerion," by P. Bade

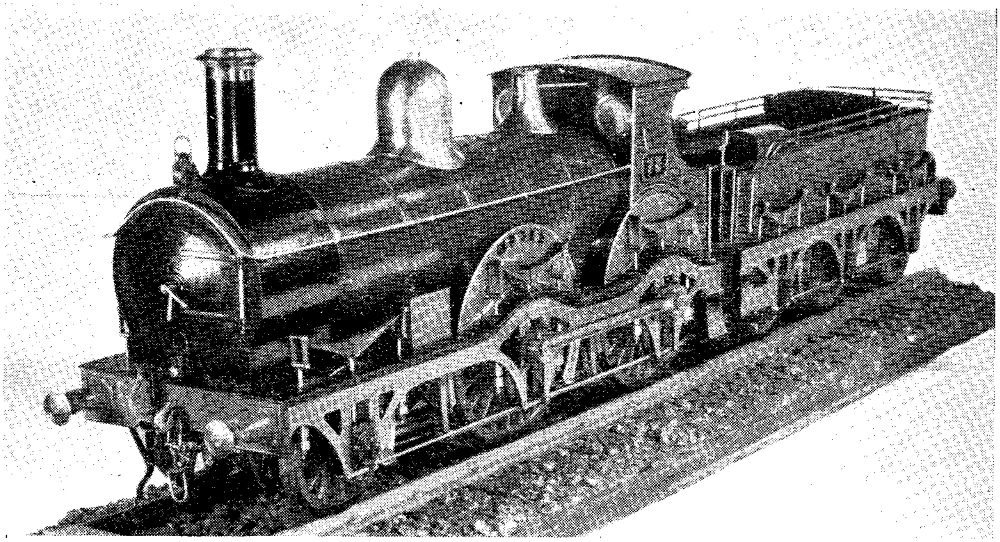
Another charming model, remarkable for its accuracy combined with simplicity, was a Brixham trawler. The general effect was most pleasing, as a glance at its photograph will show.

A case containing a miniature surface plate and a number of model tools, such as machine vices, toolmakers' clamps, vee-blocks and the like, attracted a lot of attention and won a well-merited diploma.

Considerations of space forbid



A $3\frac{1}{2}$*-in. gauge* 4-6-2 "*Princess Royal*" *class locomotive by C. N. Cosmelli*



Mr. Refoy's scale model G.W.R. 2-4-0 *No.* 73, "*Isis*"

our mentioning all that was to be seen at this very enjoyable exhibition; but we think our Kodak friends really excelled themselves this year, not only in the quality and interest of the exhibits, but also in the arrangement of the whole show.

To Stamp Collectors

Included in Robson Lowe's Postal History Auction, which will take place at 50, Pall Mall, on May 7th, are nearly ninety lots of *Railway Newspaper, Parcel and Letter Stamps.* These had a considerable vogue some sixty to eighty years ago, but interest flagged when H. L'Estange Ewen's priced catalogue of these items was no longer issued. Interest now appears to be reviving (particularly since they have been listed in Robson Lowe's Encyclopaedia, Volume I) and many collectors are discovering not only the remarkable variety of services for which they catered but also, in many, their outstanding beauty of design.

Besides the Railway Letter Stamps which usually bore a current postage stamp, provision was made for the carriage on the railways of other articles such as milk, grain, sugar samples, farm produce, market basket, etc., as well as newspapers and parcels.

Among the lots are many examples showing the means by which a particular letter or cover reached the recipient by the co-operative linking of ship, rail, tram and post office services.

*A Split-Single Two-Stroke Engine

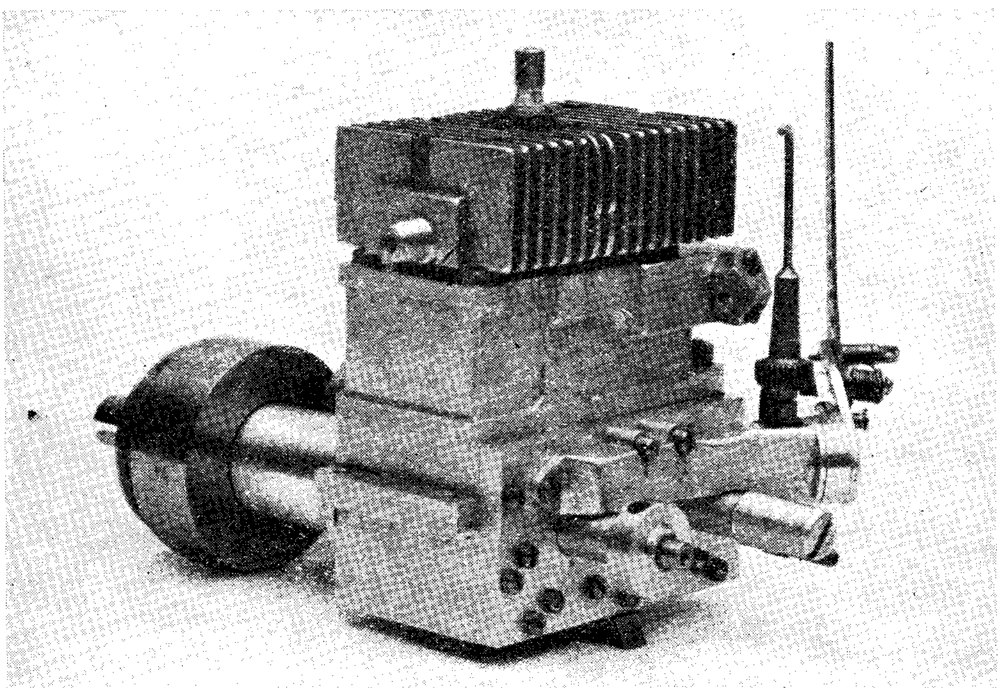
An efficient unit for propelling a class "C" Hydroplane

by R. E. Mitchell

THE pistons were next on the list and are shown in Figs. 19 and 21. These were machined from cast magnesium alloy bar. This material has been used in all previous engines and has the advantage over the aluminium alloys in that its density is considerably less.

This enables the reciprocating weight to be kept to a minimum, but against this is the poor corrosion resistance of magnesium alloys but it appears to be adequate. The transfer piston is comparatively short to ensure a good gas flow from the crankcase to the transfer ports. In this design it does not matter if the transfer ports are uncovered at top dead centre. The inside of the piston is machined away as much as possible to reduce weight. The exhaust piston is made slightly longer than the stroke in order to accommodate the crankcase compression ring at the bottom of its skirt. Since the M.P.B.A. rules demand a silencer, no attempt was made to increase the volumetric efficiency by allowing the piston to uncover the exhaust port at top dead centre. The exterior of the exhaust piston is not in communication with the crankcase, so the weight reduction in this case was carried out on the exterior of the piston. Leaving the interior of the piston solid except for the connecting-rod slot helps to increase the crankcase compression ratio. The clearance between the piston and the cylinder is rather more than usual being of the order of 0.002 in. Since the ports are operated by piston crowns, the compression rings, of which there are two per piston, are placed as near as possible to the tops of the pistons. The piston skirts, since they play no part in isolating the transfer ports from the exhaust ports, are considerably relieved except for lands at the top and bottom. The piston ring grooves are machined by using

*Continued from page 551, "M.E.," April 24, 1952.



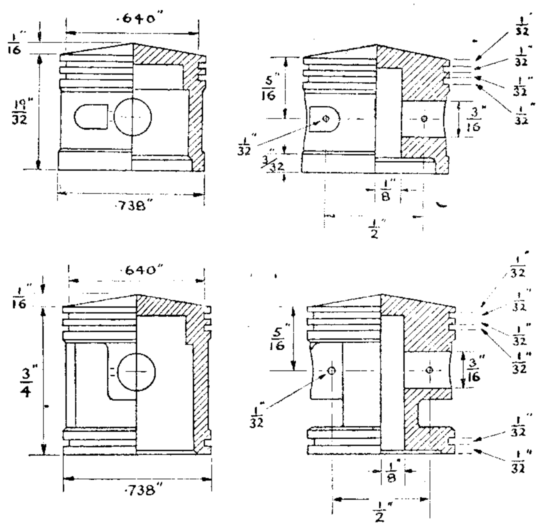


Fig. 21. *Pistons*

a parting tool, leaving a groove whose width is 0.033 in. This tool is used for piston ring grooves only. The obtuse angles for the conical crowns were left when parting-off the pistons. The holes for the gudgeon-pins were drilled and reamed $\frac{3}{16}$ in. diameter by mounting the piston on an angle-plate on the vertical slide. It is very important that the gudgeon-pins are at right-angles to the axis of the piston, and careful setting up is required so that this condition is realised. The piston rings, which are of about 1/32 in. square section, are of 1 per cent. nickel cast-iron as used for the cylinder liners. They were prepared by the usual method of roughing out a blank which is lapped to the correct thickness after which it is slotted and then compressed on to a mandrel with the gap closed before turning the outside diameter to the correct size. Fig. 22 shows the gudgeon-pins which are a straightforward turning job from 3 per cent. nickel-steel bar and are $\frac{3}{16}$ in. diameter with a $\frac{1}{8}$ in. diameter reamed hole through the centre. No end pads are used. In a previous design serious scoring of the cylinder bore had resulted from their use. To provide endwise location, the piston and pin are drilled 1/32 in. diameter at each end to take a piano wire pin. The gudgeon-pins were finally case-hardened.

From the components so far finished the connecting-rod centres were checked. It will be noticed that the big-end eyes are not symmetrical. This is to provide clearance for the balanceweights on the crank discs. Also, the web is not symmetrical to allow clearance between the rod and the crankcase which is more on one side than the other due to the employment of desaxe cylinders. The connecting-rods, as shown in Figs. 19 and 22, are made from duralumin.

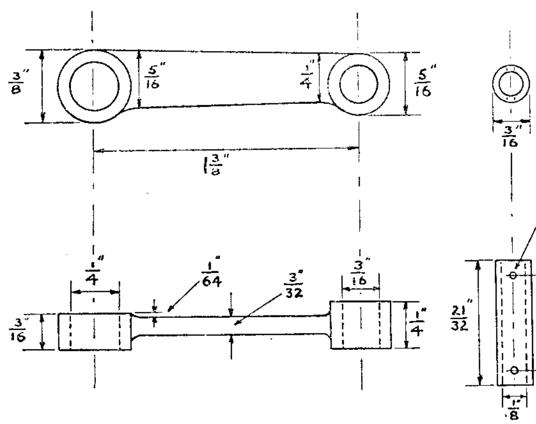


Fig. 22. *Connecting-rods and gudgeon-pins*

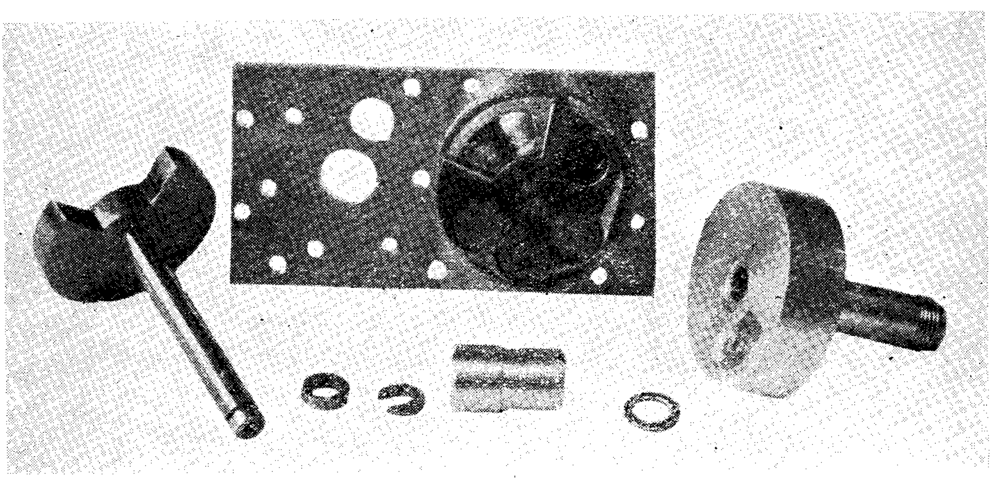


Fig. 23. *Rotary inlet valves*

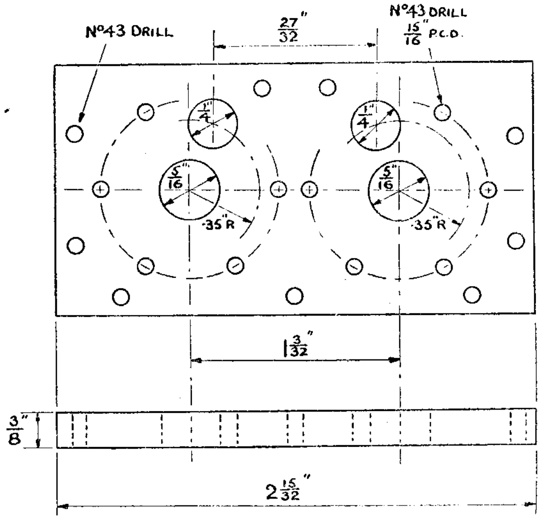


Fig. 24. Crankcase backplate for rotary inlet valves

The holes for the big- and little-ends were first bored and reamed, taking great care to ensure that they would be parallel to one another. Excess metal was removed by milling and filing. The usual "I" section is not given to the web owing to the need for keeping this as small as possible. The connecting-rods, it will be noticed, are mirror images of each other.

At this stage, the components so far made were assembled and the dimensions were checked for the rotary valve assemblies which are shown in Figs. 23, 24 and 25. The end plate consists of a rectangular plate of dural $\frac{3}{16}$ in. thick and machined on all faces; the external dimensions, at this stage, being slightly larger than those of the crankcase. Two $\frac{5}{16}$ in. diameter reamed holes were made in the required positions and at the same centre distance as the crankshafts. These were made by mounting the work on the vertical slide and using the cross-slide index to ensure the correct centre distance. The stationary parts of the valves is a straightforward turning operation with the outside diameters being finished to size by mounting on a $\frac{3}{16}$ in. diameter mandrel. It is very impor-

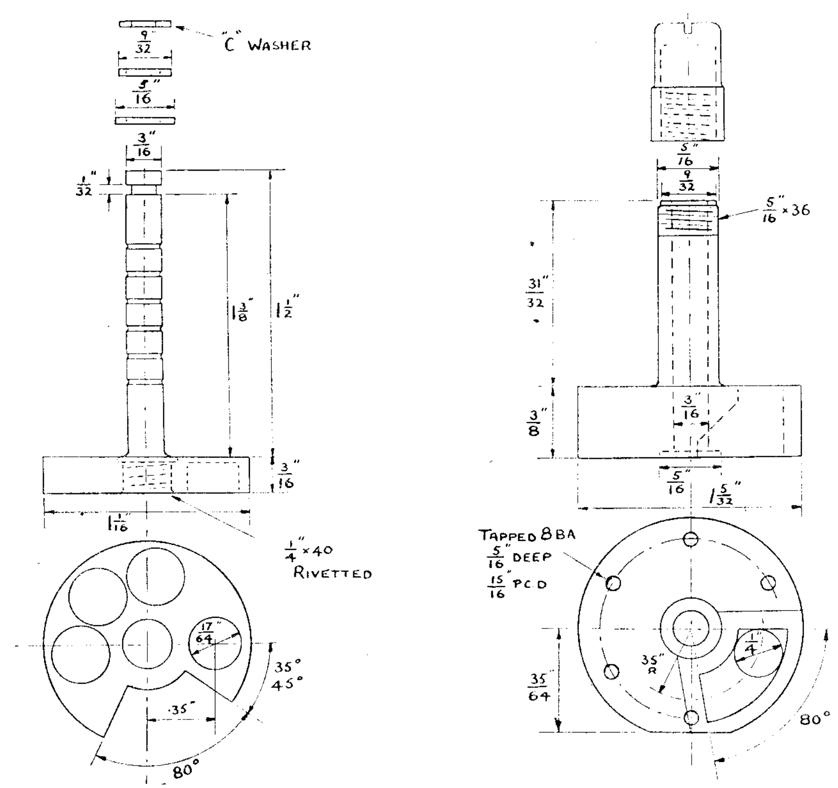


Fig. 25. Rotary inlet valves

tant that the valve face is exactly at right-angles to the bore, and absolute accuracy cannot be guaranteed by drilling a $\frac{3}{16}$-in. diameter hole of this length. The major diameters were made about 0.0005 in. smaller than the crankcase bores previously made to receive the rotary valves. Since these bores overlap, a flat had to be milled on each to enable them to be fitted.

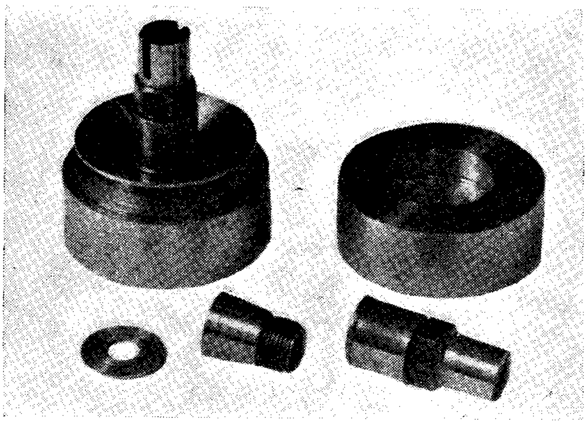


Fig. 26. Flywheels and collets

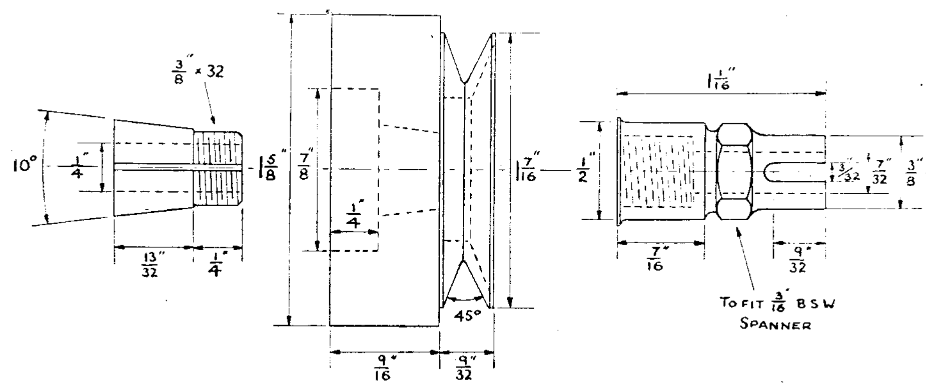


Fig. 27. Flywheel and collet

If a slight error has been made in the centres of the two $\frac{5}{16}$ in. diameter holes in the end-plate, a little scraping can correct this because a gastight joint does not have to be made here. The rotating parts of the valves have mild-steel discs on 3 per cent. nickel steel spindles. These were connected together by screwing and riveting over before finally turning to size. The whole of these parts would have been made from nickel-steel had a piece of suitable size been available. It was considered that the extra strength of nickel-steel over mild-steel would be needed on a spindle of only $\frac{3}{16}$ in. diameter. It must be emphasised that suitable radii should be left at all changes of section and given as good a finish as possible to reduce the risk of fatigue failure. It may be mentioned here that originally the spindles were made what was considered to be a good running fit in the bearings, although possibly on the tight side with the hope that they would run themselves in. On first running the engine, however, one of the spindles seized, although not seriously. The pick-up on the spindle was removed and the diameter was reduced by 0.0005 in. An oil hole was also provided for extra lubrication. One of the spindles was allowed to extend for $\frac{3}{8}$ in. beyond its bearing with the idea of providing for a magneto drive. The other is located endwise by a "C" washer in a circumferential groove and retained by a screwed cap.

The cut-away portions of the valves were removed by saw and file. It was intended that balancing should be effected by drilling three blind holes nearly through the thickness of the disc and each was counterbored slightly to receive a disc of brass 0.010 in. thick which was soft-soldered in position, so as not to reduce crankcase compression. This, however, did not achieve complete balance, so as much metal as possible was filed away from this region, and even now they are not completely balanced.

The flywheels, which are shown in Figs. 26 and 27, were turned from medium carbon-steel salvaged from an old drilling machine spindle. The diameter of the wheels is governed by the centre distance of the crankshafts, and doubt was expressed as to whether they would be heavy enough at $4\frac{1}{2}$ oz. each and a diameter of $1\frac{5}{8}$ in. Subsequent running has proved that the fears were groundless. Most of the weight is concentrated in the rim and the back side is counterbored to place as much weight as possible over the bearing and to prevent overhang. The

bores are made taper with a total included angle of 10 deg. The groove for the starting cord is machined integral with one flywheel. Most starting pulleys appear to be made too large in diameter to give the engine the required spin to start it, but if the groove is made with an angle of not more than 45 deg. no slipping of the belt is experienced. The collets are machined from 3 per cent. nickel-steel left in normalised condition and have a 10 deg. taper to correspond with the flywheel bores. They each have one longitudinal split. The clamping nuts, one of which, of course, has a left-hand thread, also form the female portions of the inboard universal joints and are case-hardened, but the threaded ends are tempered back slightly. This was carried out by standing the nut in water, covering the portion to be left hard and playing a flame on the part above the water line. The threads are $\frac{3}{8}$ in. diameter × 32 t.p.i. and were cut in the lathe. When first running the engine with fixed advanced ignition timing, the flywheels occasionally turned on the crankshafts due mainly to the violent acceleration made possible with the rather light flywheels. Owing to the same cause, similar difficulty was also experienced with the magneto rotor and couplings. Since using a glow plug, however, this trouble has never been in evidence because it is possible to start the engine on a much more nearly closed strangler setting.

Figs. 17 and 28 show the cylinder-head which was cut from solid dural and is machined all over. Clearance was machined for the conical piston crowns at the required centre distance. Exact measurement here is unnecessary. To connect the two cylinder bores a passage was cut by hand and is approximately $\frac{1}{2}$ in. × $\frac{1}{8}$ in. cross-section midway between the two cylinders. The head was reversed and drilled and tapped $\frac{1}{4}$ in. × 32 t.p.i. to take 5/32 in. reach plugs. The plug joint seating was machined at the same setting. It will be noted that the plug is offset by $\frac{1}{8}$ in. towards the transfer cylinder. This was done because the mixture in this vicinity will in all probability be less diluted with exhaust gas, making for easier starting and higher flame speeds through the mixture. The last operation on the finned belt was to machine a lug on each end which is tapped 4 B.A. These are to take tie-rods to enable the engine to be more rigidly held in the hull and to distribute some of the load imposed on the crankcase holding-down lugs, the bolt centres being only about 1 in.

The induction ports in the end cover of the crankcase are each $\frac{1}{4}$ in. diameter, which may be considered small by modern standards. There is, however, sufficient metal for these to be opened up although this has not yet been attempted. It was rather a problem to design a suitable induction manifold. Two carburettors were considered but were abandoned because one would foul the magneto if it was ultimately decided to use this form of ignition.

(*To be continued*)

For the Bookshelf

The Beauty of Old Trains, by C. Hamilton Ellis. (London: George Allen & Unwin Ltd.) 148 pages, size 6 in. by 9 in. Eight coloured plates, 60 halftone reproductions. Price 20s. net.

This is a most unusual book, but one that can be read and enjoyed by anyone who knows the fascination of a railway train. To most of the older generation, however, railway trains have now lost much of the beauty that was once theirs, and Mr. Hamilton Ellis has done well to recall and to give something like permanent record to facts which were in danger of becoming lost. He does it most successfully in this, his latest contribution to railway literature, by recounting his early impressions and the modifications which he later thought necessary to make in them.

His well-known style of writing is much in evidence, though he wisely leaves his readers entirely free to decide whether or not they agree with his opinions. But he is always entertaining and frequently amusing.

The eight coloured plates are worthy additions to the still-too-rare visual evidence of the colours of old trains and locomotives, and most of the subjects are uncommon. The photographs, from which the sixty halftone illustrations (which are printed on twelve inserted art-paper pages) have been prepared, are just right for such a book and were obviously selected with the greatest care. We note two slips in the captions: first, the engine seen in Fig. 35 cannot be the *Albert Edward*; the trailing hornblocks show that she was originally a 2-2-2 later altered to 4-2-2. Although it is difficult to decide precisely from scrutinising a halftone reproduction, the number appears to us to be 3021, which would mean that the engine is actually the old *Wigmore Castle*, one of this class which was originally built on the 2-2-2 wheel arrangement. The second slip concerns Fig. 54; the 4-4-2 tank engine seen in this picture must be No. 1126; the G.C.R. locomotive bearing the number 126 was a 0-6-0 tender engine designed by Parker and built about 1894.

We are interested in Mr. Ellis's comments concerning the marked similarity between the Great Northern locomotives and stock, and those of the Great Northern of Ireland. The fact is that J. C. Park, who introduced English Great Northern features to the G.N.R.(I) was formerly a draughtsman under Patrick Stirling at Doncaster; Mr. Ellis was evidently unaware of this.

All the same, this delightful book seems destined to find a place among the classics of its kind.

IN THE WORKSHOP

by "Duplex"

No. 114.—A High-speed Drilling Spindle for the Lathe Tailstock

THE usefulness of the lever-feed tailstock may be greatly enhanced for certain classes of work if a drilling spindle, driven from an independent motor or from a simple lathe overhead, can be incorporated. The device that is now to be described appeared in THE MODEL ENGINEER some years ago.

Since the drilling spindle was first made, a number of alternative uses for the device have presented themselves.

So, in response to many requests, the drawings of the drilling spindle have been brought up-to-date and the attachment is again being described.

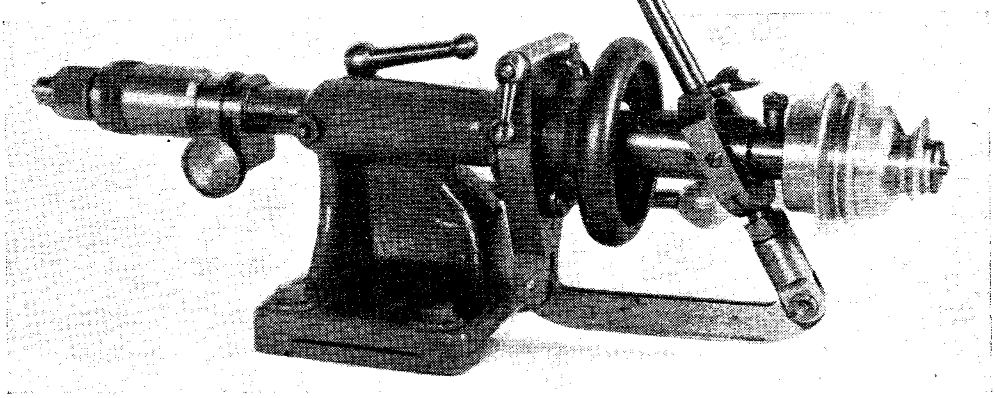


Fig. 1. The drilling spindle mounted in the tailstock

This device enables small holes to be drilled rapidly in work held by the lathe chuck. When using the attachment the work is rotated in the opposite direction to that of the drill. This increases the cutting speed and also keeps the drill upon a straight course. As an example of the speed of drilling, it was found that a No. 50 drill would penetrate into a piece of mild-steel at the rate of $\frac{1}{2}$ in. in five seconds. Moreover, there was no necessity, if the projection of the drill from the jaws of the chuck was kept as short as possible, to first use a centre drill.

In designing the drilling spindle, illustrated in Fig. 1 and in section in Fig. 2, rapid removal of the attachment was considered to be essential so as to free the tailstock as quickly as possible for normal duties. This provision has been met by making the attachment in two complete assemblies. The first assembly consisting of the drilling-head and the spindle illustrated in Fig. 3 at *A*, and the second comprising the driving pulley and its adapter seen in Fig. 3 at *B*. The drilling-head may be unclamped from the tailstock barrel by slackening the clamp-screw *G*, Fig. 2, and both the head and the spindle may be withdrawn if the locking-screw *P*, holding the driving dog *O* in place, is first removed. The operation of removing the drilling spindle itself is thus reduced to a matter of seconds, for practice has shown that the removal of the driving pulley is not necessary, and it can usually be allowed to remain in place. However, should it be found necessary to dismount the pulley, the removal of a single screw from the tailstock barrel adapter Part 3 of the Lever Feed Tailstock Attachment previously described, permits the driving pulley adapter 1 to be withdrawn.

General Construction of the Drilling Spindle

Examination of the sectional drawing (Fig. 2) will show that the mechanism of the spindle is simplicity itself. There are two ball-races in the drilling-head and the end thrust of the spindle is taken directly through the front ball-race against the end of the tailstock barrel by means of a sleeve *C* and a shoulder collar *E*, the rear ball-race acting as a distance-piece. The measurements of the ball-races are $\frac{3}{8}$ in. bore $\times$ $\frac{7}{8}$ in. outside diameter $\times$ 7/32 in. wide.

The driving pulley, at the opposite end of the attachment, is carried on two large ball-races mounted on an adapter *J* that fits into the end of Part 3 of the Lever Feed Tailstock described in the previous article. The dimensions of the

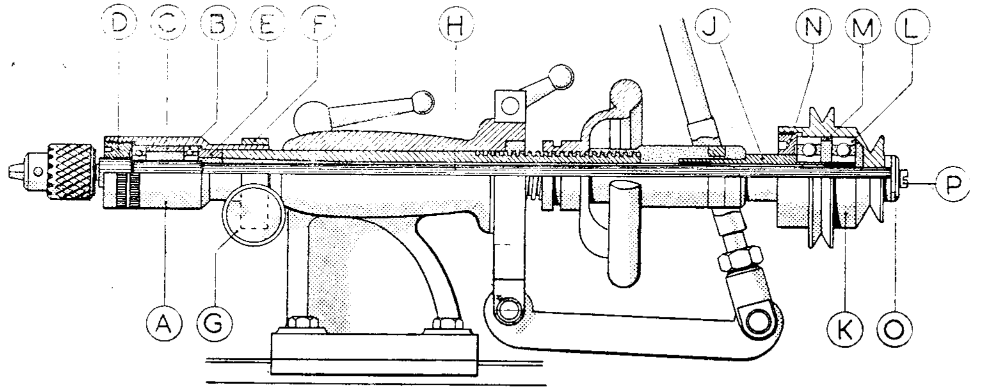


Fig. 2. General arrangement of the tailstock drilling spindle. "A"—body; "B"—ball-races; "C"—sleeve; "D"—screwed collar; "E"—shouldered collar; "F"—clamp; "G"—clamp-screw; "H"—spindle; "J"—driving pulley adapter; "K"—hub; "L"—ball-races; "M"—distance-piece; "N"—screwed collar; "O"—dog; "P"—locking-screw

two ball-races are $\frac{1}{2}$ in. bore × $1\frac{5}{16}$ in. outside diameter × $\frac{3}{8}$ in. wide. The races are held in position by a screwed collar *N* and are separated by a distance-piece *M*. The adapter *J* is fitted with two bronze bushes that assist in aligning the spindle. The bush at the outer end of the adapter is not essential and may be omitted if desired.

The drive from the pulley is communicated to the spindle by means of a dog engaging a slot machined in the end of the driving pulley and a corresponding slot formed in the spindle itself. The method used is depicted in Fig. 4 where the pulley with the end of the drilling spindle in position is seen together with the driving dog and its locking-screw.

Machining the Components of the Drilling Spindle

The machining of the parts of the device does not present any particular difficulty. There are, however, some points that call for attention. At the outset, however, it should be emphasised that care must be taken at every stage to ensure that the parts fit accurately. Otherwise the alignment of the complete drilling spindle may be impaired.

Before discussing in detail machining operations needed by any particular components, a few remarks must be made on the subject of ball-races. The fitting of ball-races is work that the amateur often finds difficult. Trouble is not usually experienced when fitting ball-races to shafts, for the shafts may be polished with emery-cloth or, better still, lapped until the race is a firm fit. It is essential that the race should grip firmly to avoid the shaft turning in the race, as it will most certainly do if rotated at high speed.

When fitting ball-races to housings, however, matters are somewhat more difficult. Though makers lay down the correct interference fit for bearings of any given size, the amateur sometimes has difficulty in machining the housings to the correct size. Whenever possible, then, it is better to arrange matters so that the ball-races are a push fit in their housings and have their outer races secured by locking-rings. This

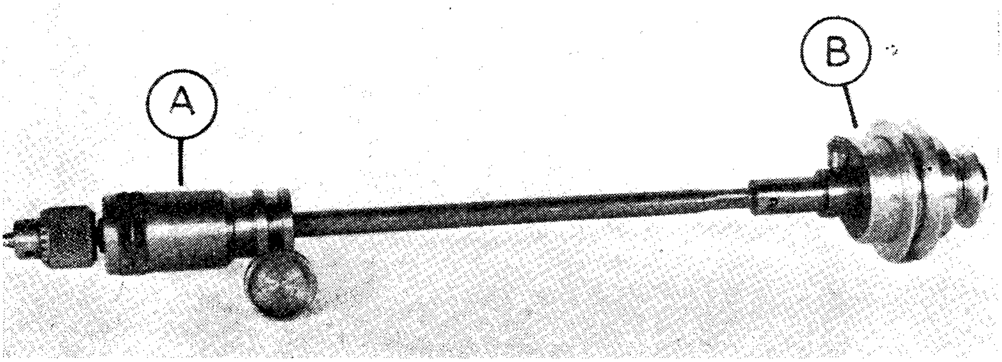


Fig. 3. (A)—The drilling head and spindle. (B)—The driving pulley and adapter

arrangement has been adopted in both the drilling-head and the driving pulley of the attachment now being described.

Races fitted in this manner may easily be removed for cleaning. When machining the housings and when the bearings are beng fitted in place, it is advisable to mount the ball-race on an arbor that will allow the race to be presented

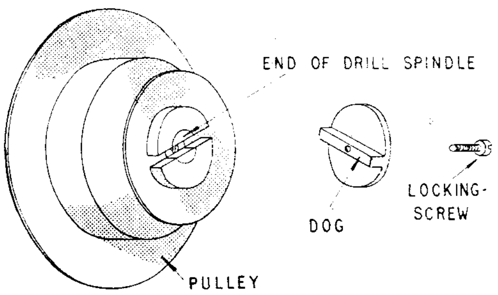


Fig. 4. Method used for transmitting the drive from the pulley to the shaft

squarely to the housing. If this is not done, there is every likelihood that the race will jam and become difficult to withdraw without, first, removing the work from the chuck. In this event, the possibility of the part being replaced, in the chuck so that it runs truly, is, indeed remote. The arbor illustrated in Fig. 5 is easily made from a short length of material. A shoulder is machined on the arbor to form an abutment for the bearing, and the arbor is then either tapped axially to take a screw or is threaded to accommodate a nut. In this way the ball-race may be held securely. There is, of course, no reason to make the arbor a firm fit in the bearing.

Ball-bearings

For further information on the subject of ball-bearings, readers are referred to the handbook, *Bearings and How to Fit Them*, published by Percival Marshall & Co. Ltd. In general, it must be emphasised that no excessve pressure should be used when assembling ball-races in place, or they may be distorted. Under these circumstances, the bearings will rapidly deteriorate in service. The greatest care must be taken to ensure that the races are clean when they are assembled, for dirt and grit will quickly ruin them. For this reason the two screwed collars, Parts *D* and *N*, have been made a close clearance over the spindle *H* and the adapter *J* respectively. As will be observed, a radial clearance of 0.002 in. is given. This clearance is sufficient to exclude swarf and will allow the spindle to revolve freely. The threads on both these collars must, of course, be cut in the lathe, and the collars should fit their corresponding parts without shake. It is unnecessary to describe the machining instructions for each individual part, as work of a similar nature has been the subject of articles many times in the past. A few notes, however, on machining certain of the components may be helpful.

The Body. Part A. It is essential that the thread, the $\frac{7}{8}$ in. dia. housing for the ball-races and the $\frac{3}{4}$ in. bore for the tailstock barrel should be machined at the same setting. This will ensure that all three bores are truly concentric. When this part of the work has been carried out, the work may be reversed in the four-jaw independent chuck, and set to run truly so that the 29/32 in. dia. end of the body may be turned.

The Adapter. Part J. Here, again, the bores must be concentric with the outside of the component. The best method is first to bore the $\frac{3}{8}$ in. dia. hole axially in the component. The work may then be mounted on a true-running mandrel between centres so that the $\frac{3}{4}$ in. dia., the $\frac{9}{16}$ in. dia. and $\frac{1}{2}$ in. dia. portions may be finally machined. If the part is machined from a piece of steel of, say, 1 in. dia., the component may conveniently be roughly machined to within 0.05 in. of finished size. This will save time when final machining is carried out with the work mounted between centres. The last operation on the adapter is the boring of the $\frac{7}{16}$ in. dia. × 13/32 in. seat for the bushes. In order to maintain concentricity, the work should be mounted on a stub mandrel formed from a short length of bar held in the self-centring chuck and made for the purpose. As there will be some overhanging of the work, the cuts taken should be light. If care is taken, however, and the boring tool is sharp, no trouble will be experienced.

The Clamp-screw (G) and Clamp (F). These two parts are of a pattern similar to those often described. It is only necessary to emphasise the importance of making the clamp a good fit on the drilling-head.

The Hub (K). All three bores of the hub must be concentric ; it is best, therefore, to machine the bores first and then, when forming the outside of the part, to mount the work on a true-running mandrel provided with a locking-screw.

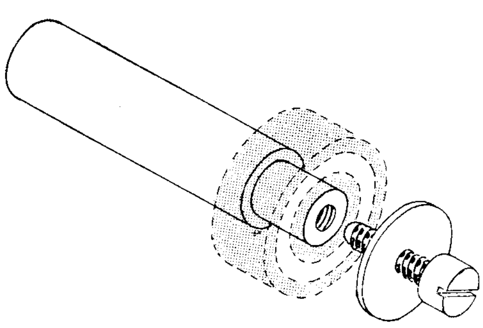


Fig. 5. Arbor for holding ball-races when fitting them

Before leaving the machining of the components that comprise the drilling spindle, it will not be out of place to refer to a method of securing the drill chuck that has always proved satisfactory. This method is described in Vol. I of *In the Workshop*, published by Percival Marshall & Co. Ltd., where full details of the arrangement are given.

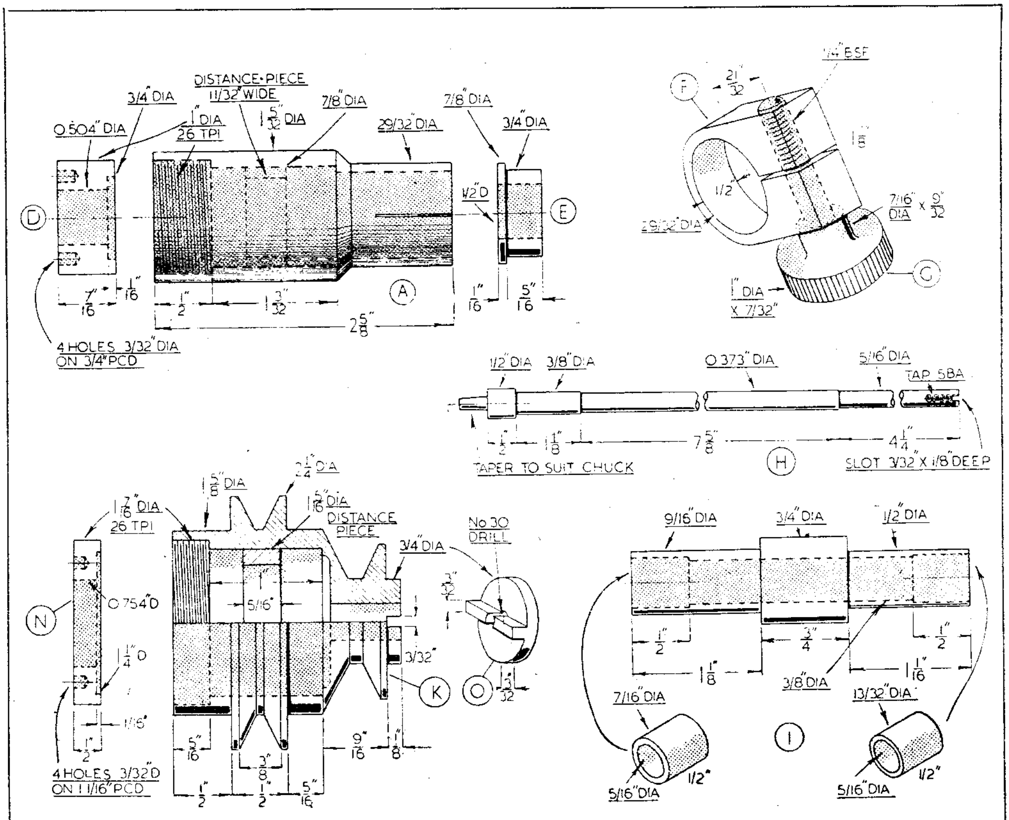


Fig. 6. Parts of the drilling spindle

However, as the matter is one of general interest, for the method may be used whenever a chuck has to be secured to a taper arbor, the details are repeated here.

The illustration, Fig. 7, shows the nose of the drill spindle together with a sectional view of the base of the chuck. As will be seen, the spindle nose is drilled and tapped axially so that a fixing-screw may be passed through a hole in the base of the chuck and so used to hold the two parts securely in engagement. In order to drill the hole in the base of the chuck, a piece of rod is gripped in the lathe chuck and is turned true. Next, the drill chuck is secured to the rod, by means of its own jaws, with the base facing outwards. The hole may then be drilled to the required size. It will be observed that the hole is also threaded internally. This is in order that a larger screw may be used to remove the chuck if necessary.

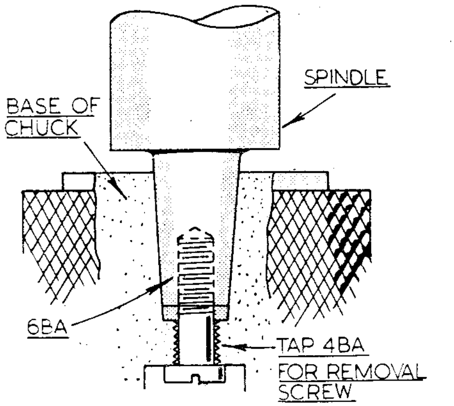


Fig. 7. Method of securing the chuck to the spindle

The size of the screw that can be employed for fixing purposes depends largely on the capacity of the drill chuck itself. A chuck of $\frac{3}{8}$ in. capacity would have a No. 4 B.A. fixing-screw, and the base would be tapped No. 2 B.A. to accommodate the withdrawal screw.

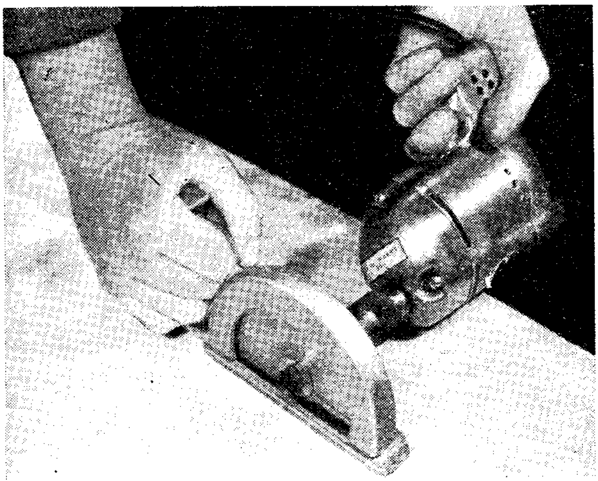
A small chuck, such as is fitted to the drilling spindle now being described, can only accommodate a small fixing-screw. In this instance a No. 6 B.A. screw should be used to secure the chuck, and the base should be tapped No. 4 B.A.

TRADE TOPICS

A Handy Circular Saw

Powered by an Electric Hand Drill

The well-known range of Picador accessories has recently been extended to include a hand-operated circular saw which is designed to be powered by an electric hand drill. A sample submitted for our inspection by the manufacturers, Messrs. H. K. Staub, proved to be a very useful tool. It was driven by a 0-$\frac{1}{4}$ in. electric hand drill during the test, as shown in the accompanying photograph. When the drill is held in the position shown, the operator can move over large flat areas without fouling.



The Picador circular saw in use, driven by an electric hand drill

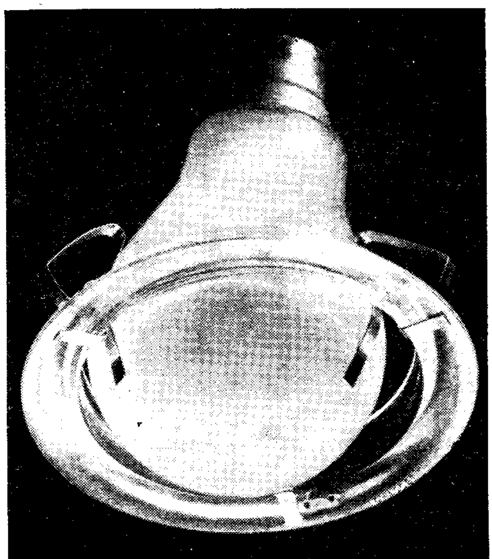
The tool consists of a 4-in. circular saw mounted on a spindle running in an oilite bush. An extension of $\frac{1}{4}$ in. dia. is provided on the spindle to enable it to be gripped in the chuck jaws of the drill. Saw guard and handle are combined in a one-piece casting, and an adjustable fence is fitted to vary the depth of cut. As the saw cuts "blind," a sighting notch on the front of the tool enables the operator to follow a marked line with good results. On three-ply and thin woods, the saw handles very well, with correspondingly slower progress on thicker and hard woods. This tool is known as the Picador Rotosaw, and may be obtained from the usual tool dealers.

A Refractor Light Ring

A device which attracted our attention at the recent Ideal Home Exhibition, and which we are sure will prove popular with model engineers is a new "Lowacost" light ring which is being marketed by Allied Distributing Corporation.

Retailing at 5s. 10d., including purchase tax, the ring is made of crystal glass in the form of a prism, and may be attached to any electric light bulb by means of three adjustable spring clips. In operation it catches dispersed light rays, and concentrates them in the required direction.

Makers claim that this gadget will increase the foot candle power brightness of bulbs by from 120 to 200 per cent., and having seen it in operation, we are inclined to agree that this figure is probably correct. Further information may be obtained on application to: Allied Distributing Corporation Ltd., 54/57, Piazza Chambers, Covent Garden, W.C.2.



The "Lowacost" light ring in situ

"Talking about Steam——"

by W. J. Hughes

★A series of articles intended to supply suggestions and information for the would-be "modeller in steam" who has not the time, the inclination or the opportunity for extensive research

4: Small and Medium-sized Stationary Engines

IN starting on the subject of stationary engines, it is difficult to know exactly *where* to commence. There are so many different varieties, from the small engine in a one-room workshop to the huge mill-engine of fifteen-hundred or more horsepower. And again, during its hey-day of well over a century, so many inventors and designers devoted their best thoughts and ideas to the steam-engine, that one could write several considerable volumes on differing points of design alone.

★*Continued from page* 431, "*M.E.*," *April* 3, 1952.

Blueprint Service

I have had several letters lately asking about blueprints, and would say that it is hoped to augment the available variety of these considerably in due course. Several makers, and many other kind friends, have been good enough to supply me with the necessary official drawings, *and* the necessary permission to copy them, but time, or rather lack of it, is the chief delaying

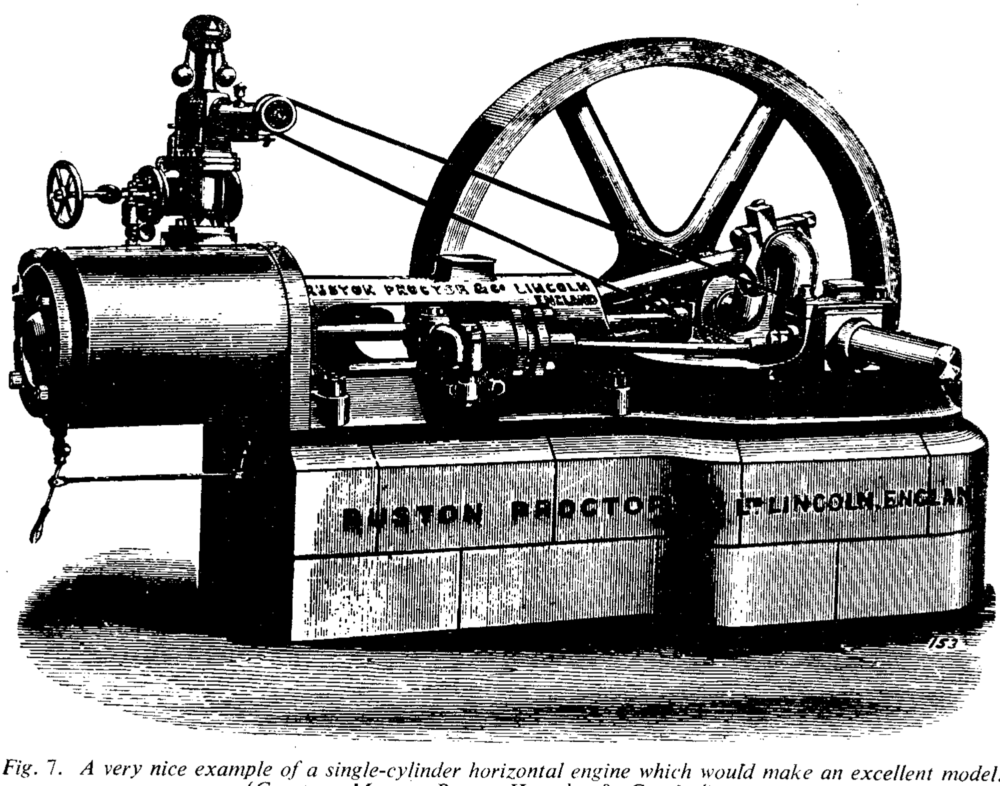
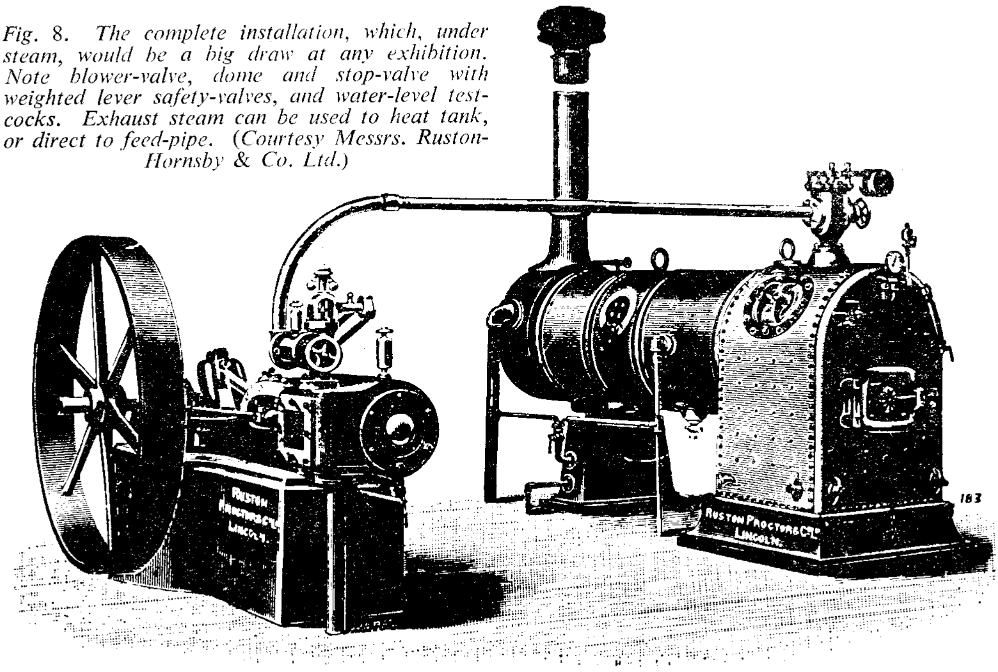


Fig. 7. A very nice example of a single-cylinder horizontal engine which would make an excellent model. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd)

factor. It's the old problem of trying to get a quart into a pint pot!

In this connection, and touching on a subject recently raised in THE MODEL ENGINEER—to wit, that of mill-engines—I have recently received drawings of a 1,200 i.h.p. cross-compound Corliss engine and have spent many hours photographing detail parts of a very similar engine of 1,500 i.h.p., and another of 850 i.h.p. These drawings and photographs will be used later in this series, with the Editor's approval, and it is hoped to deal similarly with other types of engine also.

Fig. 8. The complete installation, which, under steam, would be a big draw at any exhibition. Note blower-valve, dome and stop-valve with weighted lever safety-valves, and water-level test-cocks. Exhaust steam can be used to heat tank, or direct to feed-pipe. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)



Some Simple Prototypes

In writing this series, I am bound to assume a certain amount of knowledge on the part of the reader, but I propose to take a leaf out of "L.B.S.C.'s" book, and from time to time to introduce "Tyro's Corner," which will deal with simple principles. I have a particular sympathy for the tyro, incidentally, probably because, having had no formal engineering training myself, it only seems yesterday that I was in that class in person. But to proceed!

One of the simplest types of stationary engine is that shown in Fig. 7, the single-cylinder horizontal with slide-valve. The frame or bed-plate is cast in one piece, with an integral trunk to guide the cross-head, though some makers used slide-bars for this purpose. The cylinder, with valve-chest cast on the left-hand side in this case, is overhung from the bedplate, being bolted thereto at the front.

The crankshaft is bent from a single bar, running in brasses carried in the cast-in bearing pedestals. At each side of the crank is an eccentric, one of which drives the slide-valve, the other working the pump, which is bolted to a bracket cast in one with the frame. A corresponding bracket is cast on the opposite side of the bedplate, for reasons which will appear later.

Between the valve-eccentric and the crank is a disc which is keyed to the shaft. The eccentric is loose on the latter, but is bolted to the disc and thus driven by it. On slackening the bolt, it may be moved in a curved slot machined in the disc, thus altering the position of the eccentric relative to the crank, and varying the cut-off of the steam. If it is taken past the middle of the slot, the engine will run in the reverse direction. (This will be dealt with more fully in a later article).

A stop-valve and governor-valve are mounted on top of the valve-chest, with the Tangye type governor directly above its valve, and driven by belt from a pulley between crank and pump-eccentric.

As a guide to the dimensions of this class of engine, the table on the next page may be taken as reasonably accurate, in designing a model.

It should be noted that a bed of this type was usually symmetrical, so that an engine could be built either left handed or right-handed to suit the customer's convenience, without keeping two stocks of different castings. In addition, of course, only one pattern was needed, and complication was saved in the foundry, too.

Fig. 8 shows this engine complete with a

DIMENSIONS IN INCHES

Bore	Stroke	Flywheel		Crankshaft		Bed, O.A.		Main Bear'gs		R.P.M.
		Dia.	Face	Dia.	Length	Length	Width	Dia.	Width	
5	8	30	$4\frac{1}{2}$	$2-2\frac{1}{2}$	48	40	24	$2-2\frac{1}{4}$	4-5	200
8	12	36	$4\frac{1}{2}$	$2\frac{1}{2}-3$	58	54	36	$2\frac{1}{4}-2\frac{3}{4}$	6	160

loco-type boiler, Fig. 9 with a vertical boiler: either in model form would make a really excellent complete installation, to run or just to look at! But preferably to run!

An Even Simpler Prototype

In Fig. 10 we see an even simpler engine to build than the last one. It is actually the engine of a Ruston Proctor portable engine, dismounted from its boiler, and bolted to a masonry foundation for use as a stationary engine.

Here even the bedplate is dispensed with, of course, the crankshaft running in two pedestals bolted direct to the stonework. The thrust is taken by the two rods passing from the pedestals to the lugs cast on the cylinder. A centrifugal type of governor is fitted—we shall be dealing with various types of governor in due course,

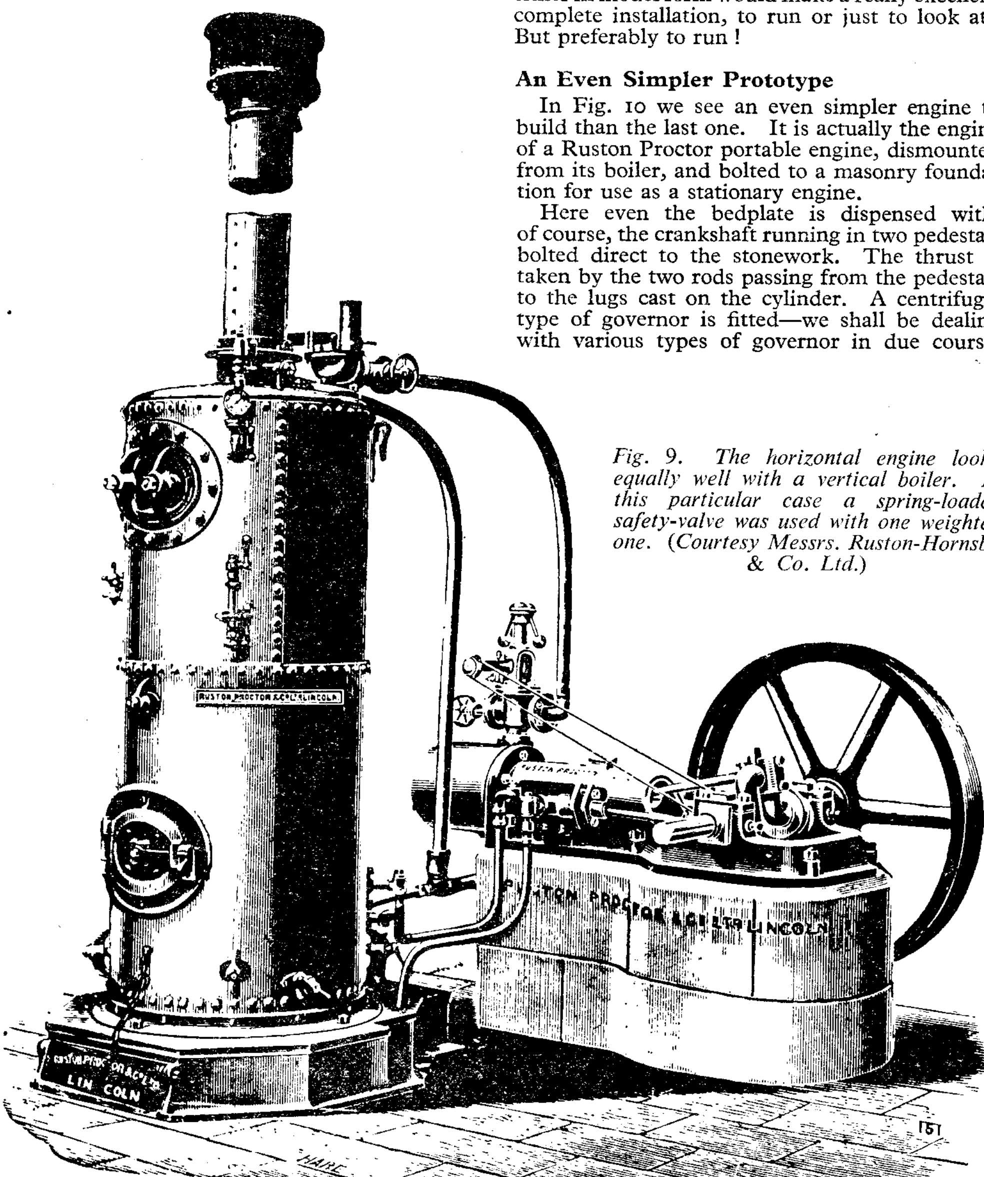


Fig. 9. The horizontal engine looks equally well with a vertical boiler. In this particular case a spring-loaded safety-valve was used with one weighted one. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)

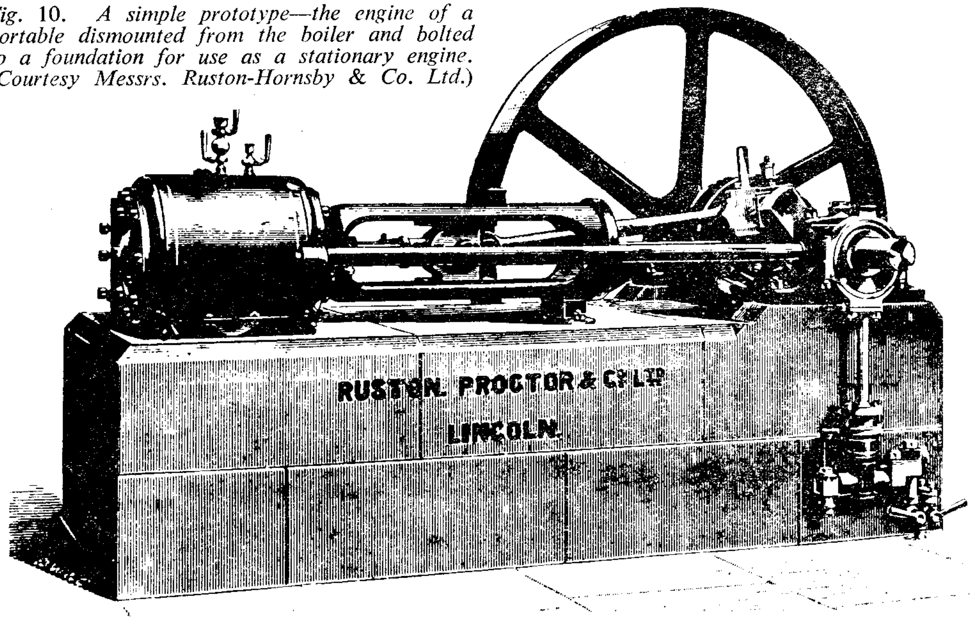


Fig. 10. A simple prototype—the engine of a portable dismounted from the boiler and bolted to a foundation for use as a stationary engine. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)

but briefly this alters the position of the eccentric so as to vary the cut-off.

A box-type cross-head is used, and the big-end is of the strap and cotter type (also to be dealt with later).

The Girder Type Frame

In the large number of model stationary engines I've seen at one time or another, I cannot recall one fitted with a girder type of bed, although this was actually quite common in the medium-size class of engine. Figs. 11 and 14 show two variations of this design, one with a support under the trunk guide, with overhung cylinder, and the other with the support cast under the cylinder itself. Fig. 12 shows a typical girder-frame, the dotted outline representing the support, where fitted. In Fig. 13(*a*) and (*b*) we see cross-sections of the frame. The dotted outline in (*a*) shows the end elevation of a foot as used under the cylinder, and (*b*) that a used under the trunk-guide.

In both cases a disc-type overhung crank is fitted, with a strap-and-cotter big-end to the connecting-rod. The countershaft is carried in two pedestal bearings, one cast in one piece with the girder, and the other separate. Inside the first is the pulley for the governor belt, followed by the valve-eccentric, or vice-versa. (The valve-chest is not seen in either of these illustrations, being shorter and narrower than the cylinder itself).

In this type of engine it was sometimes the practice to mount the pump on the side of the girder, immediately over or at the side of the guide for the valve-rod, and to drive the pump from the valve-rod crosshead. This appears to be the case in the illustrations under discussion, though I have no *definite* information as to Ruston-Proctor practice in this matter.

Bore	Stroke	Flywheel		Crankshaft		Length of bed from Cyl. Flange to Crank Crs.	Height of Centres	Bore of Trunk	Main Pedestals		R.P.M.
		Dia.	Face	Dia.	Length between Bearings				Foot	Minimum Section	
10	20	60	8	4	72	78	18	11	18 × 20	6 × 13½	110
12	24	66	10	4¾	82	90	20	12	22 × 28	7 × 17½	90
14	28	78	12	5⅝	96	104	22	13½	25 × 32	8½ × 21	80
16	32	88	14	6½	108	118	24	16½	30 × 36	10 × 25	70
18	36	102	16	7¼	130	130	26	18½	34 × 40	12 × 30	60

As will be seen, the flywheel could be mounted inside or outside the separate pedestal. The former position was the better, of course, but with the self-contained engine and boiler unit of Fig. 11 it has to be outside.

It should be mentioned, by the way, that in some designs of girder engine, an extra supporting foot was cast under the centre of the girder, at the outer end of the trunk, to add rigidity and strength.

This type of engine was frequently called "longstroke," since the stroke was usually twice the length of the bore. Ruston Proctor made the two classes as shown in sizes from 8 in. × 16 in. up to 27 in. × 52 in.

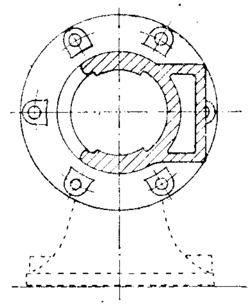


Fig. 13 (a). Cross-section at A-A. (Fig. 12). Dotted outline shows shape of foot where fitted to cylinder

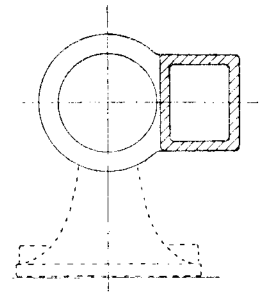


Fig. 13 (b). Cross-section at B-B. (Fig. 12). Dotted outline shows shape of foot where fitted below trunk-guide

The table on the previous page gives dimensions of girder engines, all the figures being in inches. It must be emphasized that they are only *typical* dimensions: these would vary somewhat with different makers, of course.

Modelling the Engine

In model size, working to $\frac{3}{4}$ in. scale, an engine of 1 in. bore by 2 in. stroke (16 in. × 32 in.) would have a flywheel of $4\frac{7}{8}$ in. (88 in.) diameter by $\frac{7}{8}$ in. (14 in.) face. The crankshaft would be (to scale) 13/32 in., or say $\frac{7}{16}$ in., in diameter, and the length of bed from cylinder mounting flange to crankshaft centres would be $7\frac{3}{8}$ in.; the total length, excluding flywheel, would be in the region of 11 in., or, including flywheel, $12\frac{1}{2}$ in. Just a nice size!

There would be some very interesting pattern making; the trunk could be cored out or even cast solid, as could the girder. The turning and fitting would be quite straightforward. The trunk-guide could be bored to 1 in. diameter using a boring-bar between centres, with the

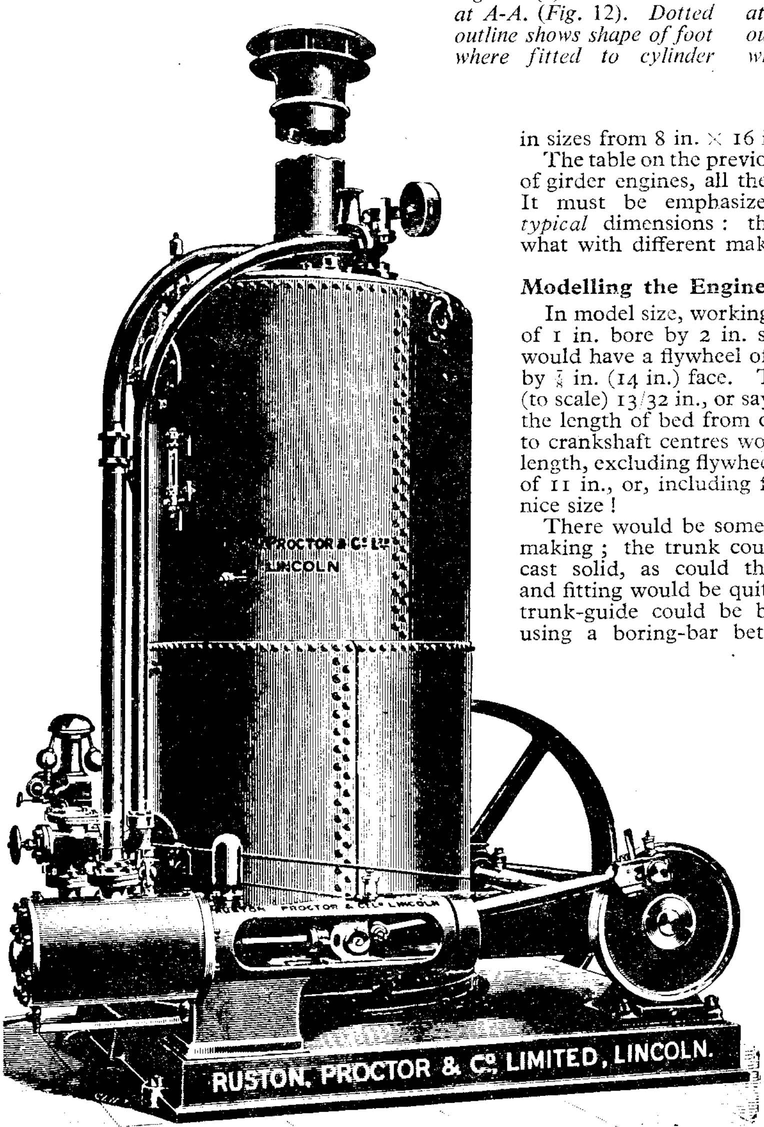


Fig. 11. A girder-type horizontal engine, complete on cast base with vertical boiler, which would make another model highly suitable for running at an exhibition. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)

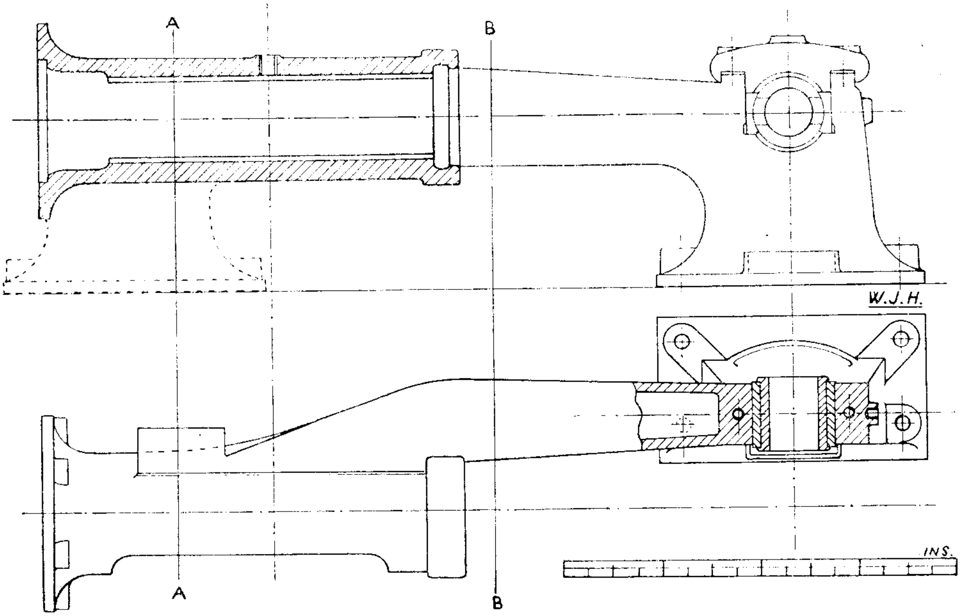


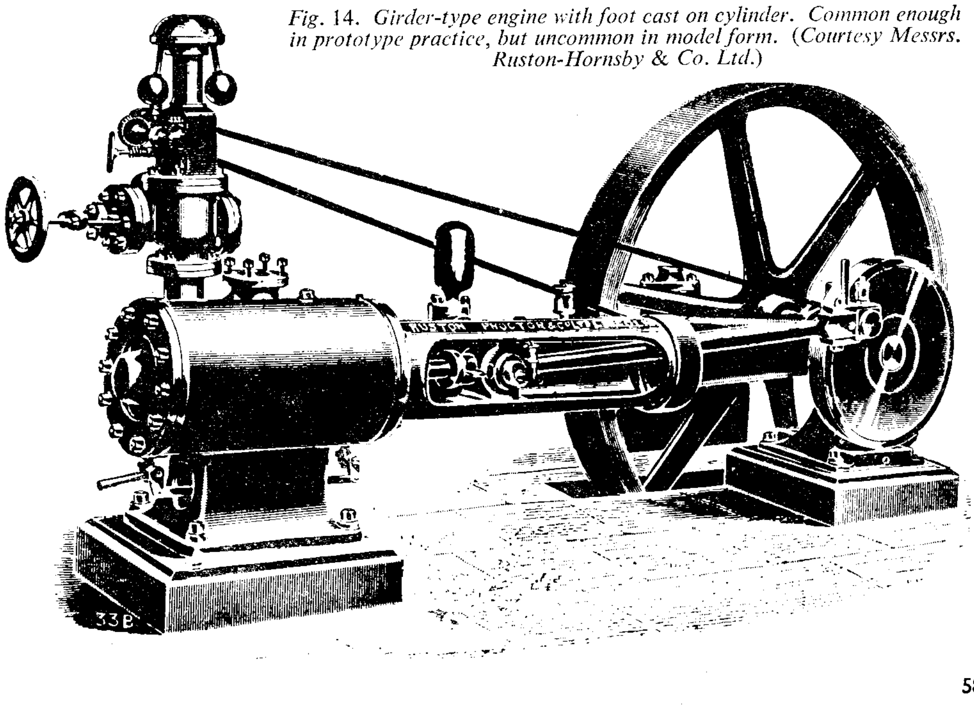
Fig. 12. Proportions of a typical girder-type frame. Note bracket for valve-guide and pump; also "oil-catchers" at foot of pedestal. Scale of inches given would make ¾-in. scale model of prototype about 16-in. bore by 32-in. stroke, though not coinciding exactly with those given in the table

girder-frame mounted on the saddle; the flange to which the cylinder is bolted could be machined at the same operation, using special cutters mounted in the boring-bar.

Such an engine would provide a nice break from other types of activity, and would not take a long time to construct, comparatively speaking.

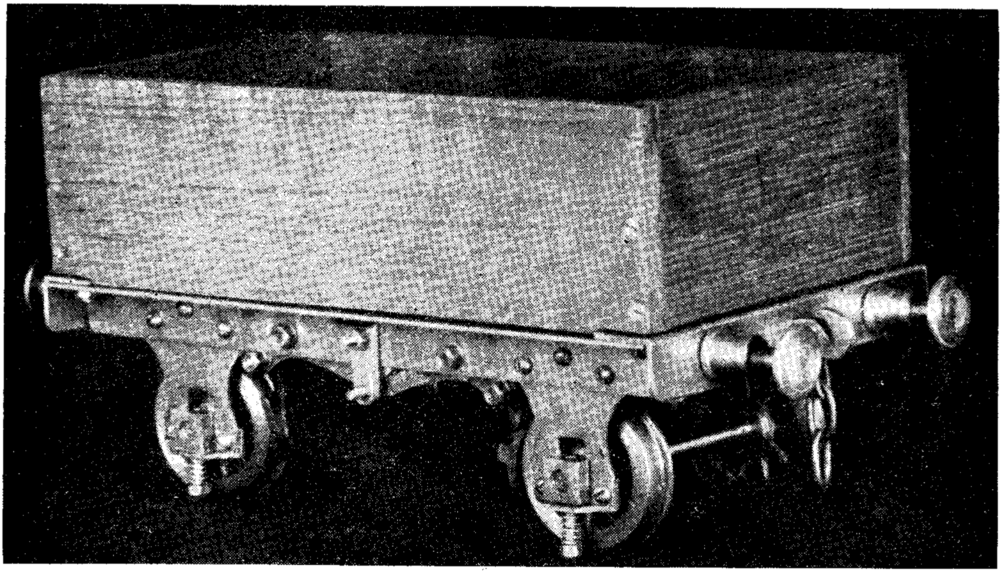
(To be continued)

Fig. 14. Girder-type engine with foot cast on cylinder. Common enough in prototype practice, but uncommon in model form. (Courtesy Messrs. Ruston-Hornsby & Co. Ltd.)



BUFFER-OPERATED BRAKES

by B. Jefferies



A model truck fitted with buffer-operated brakes

NEAR my home, the railway passes through the local Public Park with a gradient of 1 in 75. Frequently, from a path quite near to the track, I have watched trains ascending the incline, their engines proclaiming confidence in their power with staccato stentorian snorts, "I'll make my way, I'll make my way, I know I can," they seem to say.

Goods trains descend the gradient in comparative silence, buffers compressed and coupling chains hanging limp in the front part of the train due to the effect of the engine's brakes, while in the latter part, the guard's van brakes render the coupling chains taut and buffers as far apart as they can get. And it is interesting to notice what proportion of the train respectively is pushed back and held back, as it were.

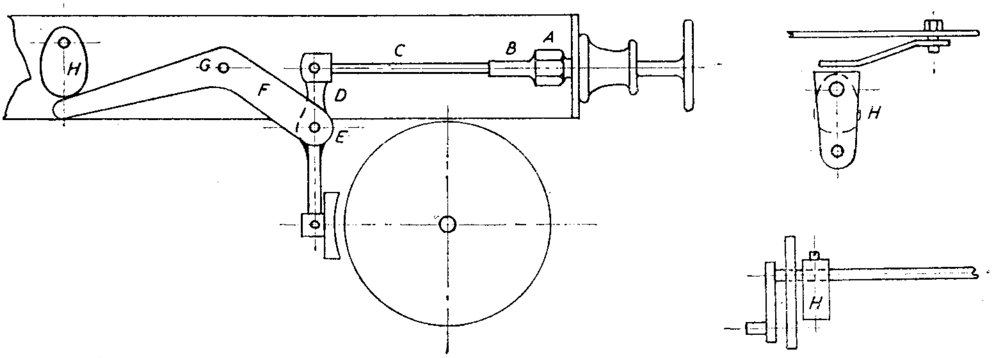
In misty or drizzly weather, I have often sympathised with the engine driver in his anxiety to keep in check the oncoming of the heavy train behind him, for there are facing points not far ahead which might be against him, and also a signal before which he must come to a dead stop if necessary.

On thinking over the matter, I have wondered whether it might not be possible to arrange for the compression of the buffer springs to operate brakes on the wagons to assist the engine brakes when descending a steep gradient.

My first impulse was to consult "L.B.S.C." who, I felt sure, would know all about it, submitting for his criticism a sketch of a possible arrangement of buffer-operated brakes. But, as I feel more at home with file and hacksaw than at the drawing board, I thought: "Why not construct a model wagon embodying the idea, send a description it to THE MODEL ENGINEER, and see what happens."

I cannot hope that my idea is original, for I quite anticipate that it has already been tried and found wanting; found guilty of numerous drawbacks and disadvantages which render it impracticable, and condemned to perpetual oblivion in the archives of far-fetched fancies such as perpetual motion, and that it has repeatedly escaped and popped up again in the guise of a dead cert, only to be promptly returned to its cell, or may be, to its pigeon-hole at the Patent Office.

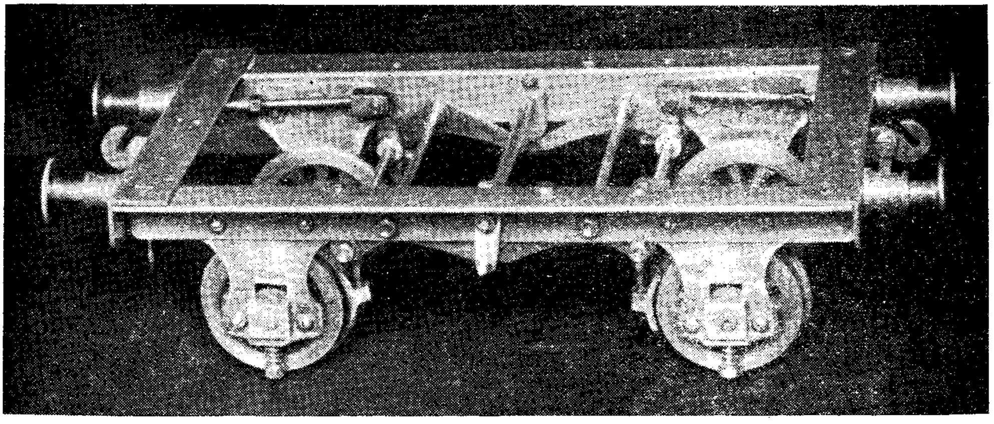
Buffer-operated brakes, of course, could only be of use when the train's journey included steep gradients or when the engine driver found it necessary owing to adverse signals or unforeseen circumstances to bring his train to a stop at short notice. If it were necessary to back the train into a siding, the brakes would be a positive hindrance and the engine's confident power song might well become a cry of impotence, "I'm sure I can't." Neither would the brakes be of use in shunting operations, so provision would have to be made to put them out of action quickly and easily.

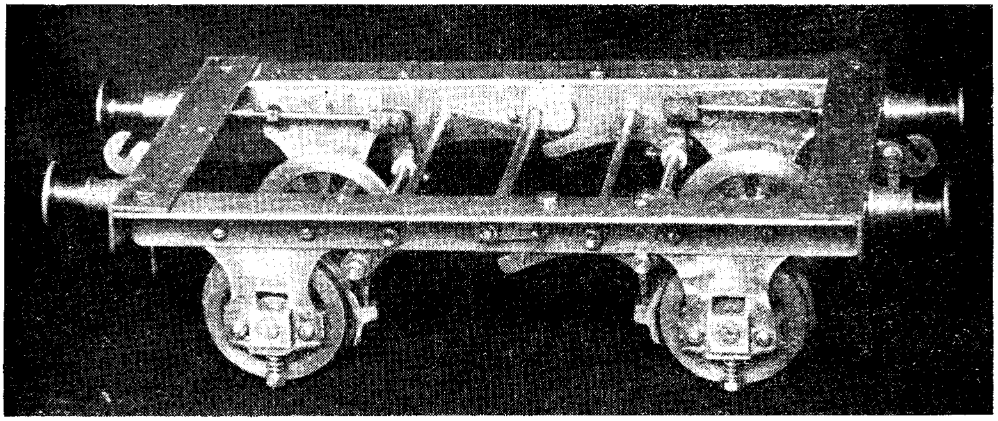


The model wagon, a description of which accompanies these notes, is of free-lance design. I did not think it necessary to build an exact replica of a prototype so long as the braking arrangement was clearly indicated. "Free-lance-manship" allows a wide latitude for construction other than that in actual railway practice, so doubtless that shown in the model wagon leaves considerable room for improvement.

The operating mechanism actually consists of an extension of the buffer stem to move the lever which applies the brake to the wheel. Instead of an ordinary nut for the buffer stem, an elongated nut *A* cut from hexagonal brass rod is used. This is fixed to a short length of brass tube *B* into which the rod *C* attached to the brake lever *D* slides. When the buffer is compressed, its stem pushes the rod and operates the brake.

The fulcrum of the brake lever *E* is attached





Above—Buffer brakes in position to operate *Below—Buffer brakes in out-of-action position*

to the end of a boomerang shaped lever *F*, whose fulcrum *G* in turn is attached to the solebar of the wagon. The free end of this lever can be moved by a cam *H* fixed on a central shaft between the solebars and operated by a handle. The effect of this movement is to move the brake blocks nearer to, or farther from the wheel treads. When the cam is in the out-of-action position, with the handle horizontal, the brake blocks are too far from the wheel treads to be effective if the buffers are compressed.

The handles are fitted with springs in order that the cam shaft shall not be moved by the jerking and jolting of the wagon on its journey.

When the train's journey includes a steep gradient, all that is necessary is for the central handle, on either side of the wagon, to be moved into the vertical position, and the buffers will operate the brakes. Of course, it will be necessary at the end of the journey for the handle to be moved into the out-of-action position. And here, also of course, the human element enters the field, for even railway servants are liable to forget what they ought to remember.

I am aware that many express goods trains have a continuous braking system, as is usual with passenger trains, so possibly in due course even coal wagons will be so braked. Then surely the buffer-operated brake idea will be content to sleep peacefully when returned to its pigeon-hole, and my concern for the engine driver when leading his heavily-laden goods train down the gradient through the neighbouring park will be a thing of the past.

My description of the buffer-operated brake would be very hazy without the photographs for which I am indebted to my friend and relative, Ralph Sanders, F.R.S.A., A.R.P.S.

PRACTICAL LETTERS

Steam Organs

DEAR SIR,—Mr. Bostel might be interested to know that in the original film of *Show Boat* a stern-wheel paddle steamer slides up to the jetty—the Show Boat, of course—and there is a steam organ, puffs of steam and hollow, rather pathetic, music and all, playing "Why Do I Love You—Why Do You Love Me?" It was strangely moving, perhaps because of a child-like simplicity in both player and music—far removed from the heady, brassy blare of the good old roundabout organs of our youth.

Yours faithfully,

Bury St. Edmunds. MILES SARGENT.

Electronic Organs

DEAR SIR,—Inevitably comes the time when, "What shall I make next," features largely in one's mind. As far as I am concerned, an electronic organ has often loomed up, but as often has disappeared again because of lack of constructional information, and of sure knowledge of the working of its inside.

Now that Mr. J. Clarke has seemingly done the impossible, vide THE MODEL ENGINEER for February 28th, could he not be persuaded to divulge his method in an article (or series of articles), particularly in regard to the method of tone generation he uses, etc.

It would at least be something original and unusual.

Yours faithfully,

Forteviot, Perth. DAVID WEMYSS.

DEAR SIR,—A further source of information for Mr. Siddons is in two series of articles in the English magazine *Mechanics*. The first series was published from July 29th, 1949 to the September 9th, 1949—the second series started on the March 16th, 1951 and concluded on the May 18th, 1951. These articles describe a rotary electro-magnetic tone generator—a simpler version of the method used in the "Hammond Organ" and also a photo-electric generator.

There is a description of the conversion of a reed organ into an electronic organ by electro-static means in the April, 1940 copy of the American magazine *Electronics*.

A Technical Monograph on Electronic Musical Instruments, by S. K. Newer, B.Sc., published by "Electronic Engineering," 28, Essex Street, Strand, London, W.C.2 at 3s. 6d. gives a lot of information. The *Electronic Musical Instrument Manual*, by Alan Douglas, published by Sir Isaac Pitman & Sons, Ltd. deals also with theory and design.

I hope THE MODEL ENGINEER will start a series of articles on this subject including a method of machining an accurate *sine wave* on the edge of a rotary generator.

Yours faithfully,

London, W.1. JOHN MITCHELL.

Twist Drill Point Grinding Jig

DEAR SIR,—I was most interested in the article by Mr. W. D. Arnot on Twist Drill Point Grinding, and would very much like to have further reports on the results, which I trust the Editor will publish.

The principle is very nearly identical in action to the machine described by Mr. T. P. Stuchfield in Volume 85, December 11th, 1941, page 469, except that the latter is much more complicated in every way.

In the latter, however, the drill axis appears to be at right-angles to the face of the grindstone, whereas Mr. Arnot's design shows this axis inclined at 10 deg. to produce a clearance angle of this value. This difference in design is most interesting and I am wondering which is correct.

Mr. Arnot should be congratulated on having provided such a simple solution to such a complicated problem.

Yours faithfully,

Hessle. H. J. MARCOOLYN.

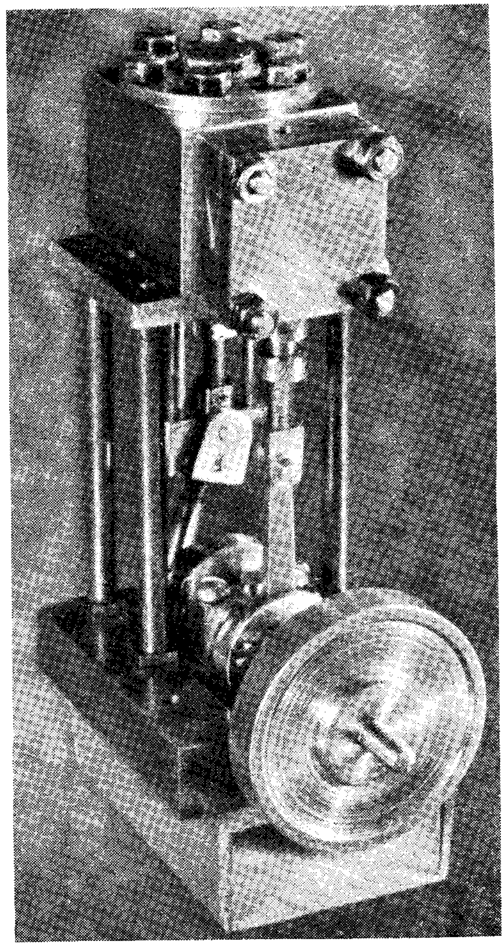
Model Engineering in Fiji

DEAR SIR,—I trust these photographs of my work will be of interest to your readers. The launch hull has not been fitted with an engine, and I am afraid that by the time an engine is ready she will not be in a fit condition for installation, for the reason that my son has been using it in its present condition, towing it in the sea, and it has suffered serious abrasions! The design was not my own, but came from an American magazine, *Mechanix Illustrated*. The model is a replica of the well-known *Chriscraft*, and was named *Bouncie II* by the author of the article in the magazine.

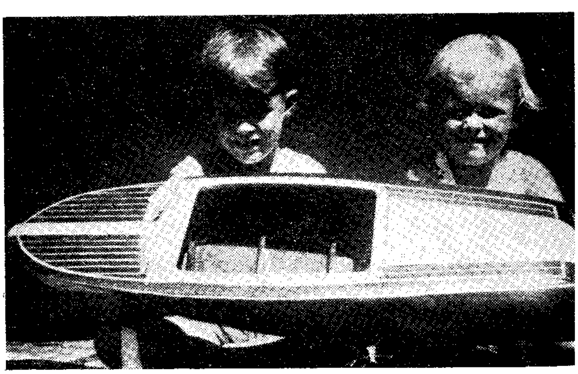
I have built a "Trojan" engine from the articles "Utility Steam Engines," and enclose a photograph of it sitting on an empty match-box. The whole thing was carved from brass scrap, and ex-aircraft bolts and nuts used from my scrap box. The photograph shows up all its many imperfections, but notwithstanding its lack of beauty, it runs merrily on steam from a pot boiler. Since taking the photograph I have mounted it on a board, with the pot boiler and three-burner "poison gas plant." Unfortunately, at the time of building, I had only Whitworth taps and dies (I have since purchased a 0-10 B.A. and a M.E. thread set) and the gland nuts suffer from eccentricity and too quick an action due to the coarse threads.

The "Craftsman Twin" fascinated me, and I had hopes of fitting it to the launch hull. I bought a set of castings from Craftsmanship Models, Ipswich, and was thrilled by their appearance. I set to work almost immediately to make the carburettor first, just to give myself practice and a little confidence before tackling the castings. This job proved successful, so I then tackled the cast-iron pistons. These too were a success, though I found the shortness of the cast-iron stick made it difficult to machine the second piston, so purchased another stick. I don't like the idea of using a mandrel, I never seem to get it running true!

Everything went swimmingly until I came to make the crankshaft. This has been my despair! I have had three attempts so far, and each has been rejected for one reason or another. I think perhaps I was too ambitious in starting on the Twin, and would have been more prudent to have worked on a single-cylinder job with a simple overhung crankshaft!



A "Trojan" engine built from scrap by Mr. Chalmers



Mr. Chalmers' model "Chriscraft" launch hull—with other "scale" models!

My workshop, however, is not confined solely to model work. I am nearly through building a 7-ft. hard chine sailing boat for my son. These, known as "P-Class" in New Zealand, are very popular. They have watertight compartments fore and aft, and use a dagger-board instead of a hinged centre-board. Single marconi mainsail (no jib). They are wonderful craft for children to sail (though "grown-ups" sail them, too). Hundreds are sailed in New Zealand. In one of the races, it is the rule to capsize once or twice at specified points in the course.

One merely stands on the dagger-board to right them, bail like fury, and then off again!

I make all my own furniture for our home in the workshop, though this is all done with hand tools—I gaze with envy at some of these American home workshops with their saw tables, planers and bandsaws! With workshop temperatures about 90 degrees and humidity about 99 per cent. in the summer, I am stripped to the waist and dripping with perspiration most of the time, but I wouldn't do without the workshop for anything.

Yours sincerely,
Suva, Fiji. I. B. CHALMERS.

Cone Development by Triangulation

DEAR SIR,—I notice in THE MODEL ENGINEER of March 13th, an article written on the above subject.

Being a foreman sheetmetal worker, with some 17 years' experience, and having actually taught the Development of Surfaces as a teacher of drawing at a North London Tech., I am most intrigued by the method shown of developing the oblique cone; it is one I have never seen used before on a true oblique cone, and I don't think that I should care to use the method, because apart from the fact that triangulation should be used on development with a great deal of care and reservation, the oblique cone is essentially a simple radial line problem, which can be used with an astonishing degree of accuracy. It rather surprises me, in view of Mr. Smith's academic qualifications, that he has shown a misapplication of principle on such a simple form; it does not seem to be generally known that textbooks written specifically for the sheet-metal worker on the development of surfaces can be obtained from the public library, and will show simple modern methods of developing any shape met with, in sheet metal, but most important, will show that triangulation methods, while being the most versatile principle, are not, by far, the most accurate and simple on certain prismic forms.

I have not enclosed the method of correctly developing the oblique cone, because obviously the argument can get highly involved, but reference to Dickason's *Geometry of Sheetmetal Work* on the oblique cone, will prove all I have said without any doubts at all.

Yours faithfully,
London, N.7. J. W. GELLATLY.
(1*st Class, C.* & *G.* (*Sheetmetal*))

Locomotive Balancing

DEAR SIR,—Mr. Westbury's reference to locomotive balancing ("M.E.," March 27th, 1952, p. 420) leaves me with the firm conviction that any railway civil engineer would resign rather than have him as the mechanical engineer! He implies that balance weights are often placed "out of phase" to avoid the effect of hammer blow and yet the arrangement shown in his Fig. 6 ensures that the hammer blow produced on the rail by the leading coupled wheel is closely followed by another delivered on the same spot by the driving wheel.

Surely the first principle of balancing is to consider the whole reciprocating and rotating system as an entity in the calculation of the position and amount of the balance weights required for the driving axle. These weights may then be distributed over the coupled wheels, if necessary, in order to reduce the hammer blow on the driving axle.

The angular displacement of the balance weights from a position diametrically opposite the crankpin is usually larger for an inside cylinder engine than for an outside cylinder engine because the horizontal distance between their line of action and that of the reciprocating parts is greater, and a displacement such as that shown on the leading wheel of Fig. 6 may well occur on the driving axle when inside cylinders are used. There is no reason, however, for this to be so on a coupled wheel—particularly for outside cylinders—for it would only act through the medium of the coupling-rod. I shudder to think of the stresses set up in the coupling-rod of Mr. Westbury's locomotive when it strikes a greasy patch of rail at speed.

Ironically enough, I recollect seeing a very good series of articles on locomotive balancing in THE MODEL ENGINEER of some 40 years ago.

Yours faithfully,
Northwood. J. PRITCHETT, B.Sc.(Eng.).

DEAR SIR,—In reply to Mr. Pritchett's criticism of my remarks on locomotive balancing, I hasten to reassure him that no railway civil engineer need contemplate resignation on my account, as I have no intention of applying for a mechanical engineer's job in this field! I claim no qualifications whatever in the design of locomotives, either full-size or model, and my reference to the balancing of locomotives was intended simply to call attention to the problems, and basic methods of dealing with them, rather than to provide a ready-made solution to them. This indeed applies to the entire subject matter of the article.

The drawing reproduced on page 420 of March 27th issue, was copied, without comment, from a published drawing of a full-sized locomotive. In the absence of exact data on the mechanical design of this locomotive no attempt was made to provide an analysis of the unbalanced forces.

With regard to my remarks on the "hammer blow" effect of unbalanced forces on the track, I understand from my reading of authorities on the subject, that it is the *simultaneous* effect of forces on two or more coupled wheels, which is most destructive, and that putting them out of phase in respect of *time*, even though they may act at or near the same *location* on the track, will alleviate the risk of trouble. As I stated in the article, I do not consider the unbalanced forces likely to be encountered in model locomotives under normal working conditions to be very serious. However, I do not wish to "muscle in" on matters outside my personal experience, and I leave locomotive experts to settle these problems for themselves; but an article on balancing small engines would not be complete without some passing reference to a type of engine which is very popular among model engineers.

Yours faithfully,
EDGAR T. WESTBURY.

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed : "Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

In all cases, the fullest possible particulars of the problem should be given, and in the case of electrical queries dealing with windings, etc., all dimensions of rotor or stator slots, or space available on transformer limbs, and cross-section of cores, are essential.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged, depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query ; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

Queries involving the valuation of models, or any matters concerned with buying and selling new or second-hand models, cannot be entertained.

No. 9937.—Electric Welding
R.H. (Wrotham)

Q.—I have a Pioneer & Johnson 230-250 V, 250 W, a.c., 12 V lighting set. Having made an electric welder to work from a battery, would it be possible to run the welding tool direct from the dynamo without harming the latter in any way. If I use the dynamo direct, will it hurt the top of same, although I have switched off all the house lights first.

R.—12 V is much too low for welding in the true sense ; 80-90 V is the usual pressure used. A form of so-called welding may be accomplished on the lines you have in mind ; local heat is provided by the use of a carbon rod and heavy current. This might be suitable for a form of brazing or silver-soldering but not for welding. No harm will be done to your dynamo, provided you do not exceed the current output it is capable of giving. Heavier currents may be obtained by paralleling the dynamo and battery, if found necessary.

No. 9951.—Materials for a Transformer
J.S. (Ealing)

Q.—I am desirous of constructing a transformer in accordance with the instructions contained in your book *Small A.C. Transformers* and venture to ask if you would be so good as to indicate to me where the necessary materials may be obtained in small quantities.

R.—Winding wires for small transformers may be obtained from quite a number of radio dealers. Various insulating materials and varnishes may, in some cases, also be obtained from these dealers. Leatheroid,Empire tape and special armature varnishes would only be obtained from the makers of these materials. Your local electricity supply company might be able to help you, or any firm in your district carrying out armature winding might be prepared to supply.

No. 9954.—Solenoid Problem
S.P. (Leicester)

Q.—I have purchased from one of your advertisers a 15C Mercury solenoid switch of the following dimensions, $1\frac{3}{4}$ in. long, $\frac{5}{8}$ in. wide glass receptacle, 1 in. long, $\frac{1}{2}$ in. wide metal solenoid. I require this to switch on an electric fire of 2 kilowatt by a timing device, for 1 hour during early morning. I have made the timing device and also a wooden former for the switch. I have wound the former several times with varying gauges of different types of wire, and for different voltages. Though in almost every case, the switch has operated, I have been unable to use it for the required time, owing to the heat that has generated in the coil. Can you tell me what number of turns and gauge of wire are needed to successfully operate the switch for one hour with 15 V to 200 V without heating up ? Has my failing been in making a wooden former, and should it have been made in metal, such as copper or brass ?

R.—As the solenoid would appear to be solid and not laminated, it is more than likely that most of the heat is generated in the iron mass. Solenoids and such like apparatus must have the iron system laminated. This heating of the iron in your case can be overcome by simply making a saw cut through the length of the core right to the exact centre, that is the method adopted where this style of core is used. A satisfactory coil for operation on the higher voltage could be 4,000-6,000 turns of 38-40 s.w.g. plain enamel-covered copper wire. The fact that you have made the former in wood has no effect whatever on the performance of the coil from a heating point of view ; on the other hand, if you made a metal former your heating would be very much worse, unless you took the precaution of slitting the entire former through the cheeks and through the tube. The former made solid in metal would act as a shorted turn of a secondary winding. You should attain satisfactory results on the lines indicated above.

No. 9956.—Motor Stampings F.S.A.W. (Guildford)

Q.—In the book *Small Electric Motor Construction*, are given the names and addresses of manufacturers and suppliers of equipment for electric motors. Neither W. H. Haselgrove nor G. L. Scott are able to supply tripolar armature stampings of 5 in. diameter. I would be glad if you could advise me where armature and field stampings can be obtained.

R.—We are extremely doubtful whether it would be possible to obtain tripolar armature stampings as large as 5 in. diameter. Motors of such a large size would almost inevitably require multiple slot armature stampings, in order to avoid excessive sparking at the commutator. In any case, the supply of stampings for field and armature laminations of any kind is extremely difficult at present, due to the restrictions in the supply of raw materials.

No. 9957.—The Zedalite Torch W.J.F. (Doncaster)

Q.—We have a self-generating hand torch which has been given to us for repair. In the absence of local information on the subject, could you please help in this matter.

R.—The self-generating torch submitted to us is a fairly well-known make, which was produced in this country before and during the war. The chief trouble with this torch is that several of the working parts are missing, including a pinion which meshes with the rack and drives through the medium of a ratchet and pawl, a large bakelite spur wheel, which in turn meshes with the pinion on the rotor spindle. It should also be noted that the return spring for the rack, which should be inside the hollow plunger of the latter, was found considerably bent and damaged, tucked inside the upper part of the torch. If the missing parts can be found, it should be a fairly simple matter to put the torch into working order. A description of the Zedalite torch, with a photograph showing the internal parts, was published in the issue of THE MODEL ENGINEER dated November 18th, 1943.

No. 9952.—Pole Sizes W.G. (Nettleham)

Q.—Although I have read several books on small electric motors, I have failed to find any reference to optimum pole sizes, i.e. the length of circumference which the magnet should embrace. I imagine this must be tied up with armature pole size, but would be grateful for any information you could give me, or references, in respect of both 3, 5 and larger pole armatured motors.

R.—Normally, an armature should be equal in length and diameter, but variations are made in design, and in some cases it may be found that an armature is twice the length of its diameter. There is not normally an armature having more than three poles ; over this number there will be slots, and in this case we do not refer to these slots, or the teeth of the slots as poles. A pole face will be the same length as the armature, the width of the pole will be governed by the style of armature winding adopted, and the width of any pole must be such that satisfactory positioning of the armature coils, and therefore, satisfactory commutation, may be attained.

No. 9955.—Pendulum Swing E.D. (Camborne)

Q.—I am at present making a half-second Hipp clock, described by Mr. F. Hope-Jones in *Electric Clocks and How to Make Them.* I have completed the pendulum, driving magnet and trigger assembly, but am very disappointed with the results. The electro-magnet boost takes every 8-10 seconds, which is the best I have been able to get, and this with the pendulum not driving the wheelwork. The pendulum has a tendency to swing elliptically, which becomes more pronounced when the armature-magnet gap is decreased. With the 0.006 in. gap suggested in the book the armature pulls down solid on the magnet polefaces. I have stiffened up the backplate by means of a $\frac{3}{4}$ in. $\times$ $\frac{1}{2}$ in. steel rib which runs the whole length of the plate, but this does not prevent the armature pulling down. The only departure from the specifications are : (1) 32-s.w.g. wire on the coils instead of 30-s.w.g. which, of course, increases the coil resistance, and various battery voltages have been tried to compensate for this. (2) The pendulum is suspended on a miniature ball-bearing instead of the conventional feather. I have noticed that closing the contacts when the pendulum is stationary causes it to pull towards one or other of the magnet coils, which led me to suspect that one coil might be giving a stronger pull than the other. I endeavoured to compensate for this by regulating the current through one coil by means of a suitable variable resistance in the hope that this would cure the tendency of the pendulum to swing elliptically, but it was not successful.

R.—The usual cause of the pendulum tending to swing elliptically or "roll" is either some fault in the suspension or else the armature not being centrally aligned with the magnet. In the normal type of pendulum suspension, rolling can be caused by a twisted or buckled suspension spring, but we note you are using a ball-race for the suspension, and we may observe that although this is often tried by constructors, the opinion of horologists is that it is not a satisfactory method. The use of a slightly smaller gauge wire on the coils should not account for any marked inefficiency, as it would only be necessary to raise the battery voltage in proportion with the increased resistance to obtain exactly the same magnetic flux in the coils. With regard to your suspicion that one of the magnet coils may be stronger than the other, this is quite impossible if the magnet is of the usual type having a yoke between the two cores, so as to form, in effect, a horse-shoe magnet. In such a magnet, one pole is bound to balance the other exactly. We suggest that it may be desirable to increase the gap clearance between the magnet and armature, as although the minimum clearance is desirable, it is often found that some deflection takes place in the parts which makes larger clearances absolutely essential.